Tall Chimney Construction.*—V.

VENTILATING CHIMNEY-SHAFTS.

A ventilating chimney-shaft was erected at the American Print Works, Fall River, Massachusetts, from the designs of Mr. Joseph A. Miller, of New York. This chimney is one of a class of which several have been erected by Mr. Miller, and its construction includes several peculiarities worthy of notice. In the first place there is formed at the base of the shaft an enlargement or hot chamber into which the waste gases are delivered by the flues, this chamber being in some of Mr. Miller's chimneys more than twice the diameter of the main portion of the shaft. In the present instance the diameter of the chamber is 10 feet, and its height 20 feet, while the diameter of the main shaft is six feet, except just where it joins the chamber and at the top of the cap of the inner shaft at both which points its diameter is five feet. The object of the enlargement or chamber is to allow the currents from the flues to be gradually diverted to an upper course, and it is more particularly useful when two or more flues open into the same chimney, and where, consequently, there are conflicting currents to contend with.

The shaft is double for the main portion of its height, the light inner shaft being the chimney proper, whilst the outer casing serves to protect the inner shaft, and at the same time forms an annular flue which is available for ventilating purposes. The inner shaft is surmounted by a cast-iron cap, this cap being built up of sections of such a shape that the center of gravity of each section falls within the line of the bases, and the sections thus tend to fall to-gether, and form a kind of arch. Each section is connected to that next it by two bolts; but from the shape given to the sections they will maintain their positions even if the fastenings were corroded away. The sections are provided at their bases with flanges which give them a secure hold of the top of the shaft. The cap which surmounts the outer casing is constructed on the same principle as the inner cap, but the sections of which it is composed are provided at their bases with flanges gripping the shaft both within and without.

When a high wind blows over the top of an ordinary chimney it acts to a certain extent as a damper and checks the draft, as any one who will watch the smoke escaping from a chimney on a windy day can easily see for himself. In the chimney now being described, the action above mentioned has been avoided, by making the inner shaft of somewhat less height than the outer one, and by piercing the latter with openings, which allow the wind to impinge upon the sides of the cap of the inner shaft. The shape of this cap causes the air entering through these openings to be deflected upwards, and this, by the well-known action of induced currents, rather assists the draught of the chimney than diminishes it.

The inner shaft of the chimney is of circular form, whilst the outer casing is octagonal, four of the sides projecting for the width of a brick beyond the line of the others. This projection of the four sides not only greatly improves the architectural effect of the shaft, but also enables the latter to be built without the use of the cut bricks required for ordinary octagonal or circular shafts. As far as possible all projections on the exterior of the shaft have been avoided, as they obstruct the upward flow of air, which is always taking place over the surface of a wall and cause eddies, which interfere to a greater or lesser extent with the free escape of the gases which the chimney is built to carry off.

We have already referred to the annular space between the inner and outer shafts, and it is the existence of this space which renders the chimneys of the class we are describing, peculiarly applicable for assisting ventilation. In the case of the chimney we describe, the annular space has a least sectional area of 2,200 square inches, and with the gases in the chimney at a temperature of from 400° to 450°, the exhaustion in the annular flue amounts to 1.15 inch of water, whilst with a high wind blowing, this is increased to 1.3 inch.

The theoretical velocity of the inflowing air due to the first-mentioned exhaustion would be about 70 feet per second, and the annular flue would then be theoretically capable of carrying off $\frac{2200 \times 70}{144} = 106.9$ cubic feet of air per second. Of course, however, this quantity would be liable to considerable reduction in practice, owing to the resistances in the air passages, etc. The exhaustion in the inner shaft varies from 1.4 to 1.5 inches of water, according to the state of the atmosphere and other circumstances.

At the Great Falls Manufacturing Company's Works in New Hampshire, a chimney of the same class as that we have described, has lately been erected in the center of a projecting tower containing the water closets, etc., these being connected with the annular flue of the shaft, so that a strong current of air is continually drawn through them.

MESSRS. ABRAHAM STOTT AND SON'S CAVITY CHIMNEY, OLDHAM.

Height of chimney, 165 feet.
Diameter at base, 16 feet by 5 feet by 3 inches thick.
Diameter at top, 7 feet 6 inches.
Height of cavity, 90 feet, 3 feet thick.

After completion it leaned over considerably on one side, and the owners entered into a contract with two brothers who were chimney builders, to "saw" the chimney; but instead of sawing, they took out a whole course of bricks, and, while one of the men was on a scaffold about a third of the distance from the ground, engaged at the work, the stack fell over, except about 30 feet from the base, and killed the man who was working at the time.

CAVITY CHIMNEYS.

This form of chimney is frequently built in the North of England; the inner ring is carried up vertical of 4½ inch fire-brick, for, say, 20 to 30 feet high, until it nearly closes with the main shaft.

The outer or main shaft is started with 14 inch work at base, and diminishes or batters regularly towards the top.

ABBEY MILLS SHAFT.

Extract from letter:—

I took no account of the work till we reached the top of base or starting of column.

Concrete, 30 feet 6 inches by 30 feet 6 inches by 8 feet thick.

York landings.—Two layers of York landing six inches to cover the whole of the concrete—bedded solid.

Brickwork from top of base to underside of stone head, 131 feet.

Bricklayers' Time.—Time of bricklayers and laborers from stone base to underside of stone head, 525 days; bricklayers' laborers, 590 days.

Cost of labor only.—About £8 per rod.

Time.—Started laying bricks on stone base 20th of July, 1867; finished the column to underside stone head, 9th of November, 1867.

Portland stone.—Top of column or stone head, 900 cubic feet or 60 tons; masons 72 days; laborers 144 days, for getting up and fixing only; this is about 1s. 2d. per foot.

Raising Bricks, etc.—The means of raising the brick and stones on shaft was by a small donkey engine, chains fixed round wheel top and bottom of shaft after we got 50 feet high.

Scaffold.—Time made in building scaffold, and also taking down same, 677 days building, and 150 for pulling down.

Scaffold.—Number of scaffold poles used for one shaft only.

Poles to shaft	428
Poles to barrow lift	18
	446

Cords used to standard		324
" "	barrow lift	54
" "	braces	214
" "	ledgers	544
		1138

Twenty-seven tons of iron-work used on stonehead.

ON THE ROYAL PORCELAIN WORKS, WORCESTER, THERE ARE THREE LARGE STACKS, VIZ.:—

1st. Octagonal, about 100 feet high, with a fine ornamental top in brickwork. This chimney, owing to the foundations giving way, was in 1866 2 feet 4 inches out of the perpendicular; but in that year was set upright by a piece being sawn out of one side at the base.

2d. Is a chimney erected in 1866. The base is 15 feet square. It is carried up square for 30 feet; then in an octagon shape; and, finally, in a circular form to the height of 171 feet. Forty feet of the shaft is 10 inches in thickness, being composed of double bricks; while the remainder is of single bricks, 13 inches by 5½ inches with a groove in the centre. The stack is screwed down with eight iron pins, and there are iron rings and supports every 12 feet. The cornice is made of brick, and the whole is surmounted by an iron cap over 2 tons in weight. At the time this chimney was built only one other had been erected on the same principle—namely, at Buckley, Morton, in North Wales; but that one is not so high.

3d. Is about 180 feet high, and 48 feet diameter at the base. It is built in a square form, and has no pretensions to ornament.

RETORT HOUSE SHAFT AT THE SOUTH METROPOLITAN GAS WORKS, OLD KENT ROAD, LONDON.

Cost £530.

Total height above ground line, 108 feet.

Depth from ground to bottom of concrete foundation, 9 feet 9 inches.

Flue 5 feet square, and parallel throughout its length.

80,000 bricks used in the structure.

Weight of cast-iron cap, 2 tons.

The intertor of the flue is lined with fire-bricks throughout its height, the fire-bricks being built in with the stock-bricks in old English bond of alternate layers of headers and stretchers, so that the courses of fire-bricks are alternately 9 inches and 4½ inches thick, and were specially obtained for this chimney of the same size as the stock-bricks.

The retort house shaft, erected in 1862, has been in work ever since, and has not burnt away at all; the fact is, the heat of a chimney is not sufficient to injure good fire-bricks.

Fire-bricks are usually thinner than stocks. Mr. Livesey sometimes adopts the plan of bonding them into the stocks every sixth or eighth course, where the courses coincide.

In a similar chimney-shaft, 70 feet high, recently erected entirely of fire-bricks for the new engine-house at these gas works, Mr. Livesey carried up the 14-inch work about 50 feet, and then reduced it to 9-inch work to the top of a set-off inside, so that the flue is larger at the top than at the bottom.

FLOUR CHIMNEY-SHAFT, BOSTON.

Built from designs and under superintendence of W. H. Wheeler, C. E., Boro' Survey of Boston, Lincolnshire.

Height from floor line of mill, 105 feet 3 inches to top of cap.

Cost about £350.

There are about sixteen rods of brickwork in (it is not measured solid), and about 740 feet cube of Bramley Fall stone.

Iron cap at top 4 feet 6 inches diameter, 9 inches wide, 9 inches deep on inside, and 3 inches deep on outside, and 1 inch thick, with flanges and bolts.

The chimney is built on piles, nine in num-

*A paper by R. M. Bancroft and F. J. Bancroft, read before the Civil and Mechanical Engineer's Society. Reprinted from *American Architect*.

ber; the shoes of piles are 30 feet below floor line of mill.

The upper part of soil is silty clay, and the lower part hard clay and chalk stones.

CONCRETE CHIMNEY AT SOUTH DOCKS SOUTHERLAND.

In compliance with the requirements of the Board of Trade, the Biver Wear Commissioners have erected from the designs of their engineer (Mr. H. H. Wake, Assoc. Inst. C. E.), large chain cable and anchor testing works, at their South Docks at Sunderland.

The whole of the buildings are constructed of concrete, built with Tall's patent apparatus, by Mr. George Grainger. The design included two boiler-house chimneys, one of which has just been completed, and as it is believed to be the first chimney of the kind built of concrete, and without scaffolding, in this country, some brief description of the manner of its erection may be of interest. The chimney is carried up square until it is well clear of the level of roof of testing-house, the dimensions being 22 feet 3 inches by 7 feet 6 inches by 7 feet 6 inches, the construction of this portion presenting no feature of novelty. At this level the corners are gradually taken off the square base, until at the height of 24 feet 9 inches above the surface of ground, it is brought into the octagonal form of the tapering portion of the chimney, that the profile of base mould might be shown to greater advantage. This octagonal and tapering portion of chimney, in which the interest and difficulty of the work chiefly centered, was moulded in the following manner:

Panels 3 feet in height were formed of ¾ inch boards, hinged together in pairs at their outer edges, being so proportioned that the lines of their inner edges, when produced, came into one point at the center at half the height of this section of the chimney, the intermediate space being made up by a wedge piece, which after the concrete poured between the panels on inside and outside of chimney walls had set, was easily reduced to meet the decrease in size on the next left due to the batter, this reduction being just sufficient to take off the holes in one side of the wedge for the stud bolts, which connected it to the upright members of the frame. When the stalk of chimney had been carried up to the half of its full height these panels were sufficiently reduced to admit a second set of intermediate wedges of exactly the same dimensions as those introduced at the level of base mould, bringing the inner edges of the reduced panels into one point at the center of the top of chimney in a manner similar to that in which, at their original dimensions, they had been brought together at half of its height, affording a tolerably severe test of the accuracy of work, which it was found to bear admirably, for the uprights being 6 feet in length, and always being moved with the panels which were only half that height, they had a continual hold of 3 feet on the completed portion of the work, which sufficiently insured regularity in line. The chimney when completed was stuccoed with cement, and drawn in courses to imitate stone; it is considered to present an excellent example of concrete building, both as regards strength and appearance, the latter being of a highly ornamental character, the chimney being exactly perpendicular, and the mouldings, which were formed in their respective positions, clear and sharp in outline. The concrete for the work was specified to be mixed at the rate of one part of Portland cement to eight of gravel, but in the case of the chimney the proportion was increased to one in five by the contractor, by whom also the simple and efficacious arrangement used in building was devised.

PRINTER'S ink has made more fortunes than have ever been made on all the stock exchanges and in all the gold mines in the world.

A Great Drainage Enterprise in Illinois.

TORONTO, ILLINOIS, October 22.—A feat in drainage engineering, probably surpassing any ever before attempted in this country outside the Everglades of Florida, is now being successfully prosecuted in Illinois.

The work consists of a canal 15 miles long, 35 feet wide, and 7½ feet deep, situated in the eastern part of Platt county. It runs through a large tract of low flat prairie, subject to annual inundation, having no natural drainage or outlet. The dredge boat used in its construction is 76 feet long, 26 feet wide, and cost its owners, Pallard.Goff & Co., $24.500. Fourteen hands are employed upon it, and the dredge advances about 400 feet a day.

As far as completed the results of the work are very satisfactory, having lowered the water level in the surrounding country almost equal to the depth of the canal. About 20,000 acres of overflow lands will be reclaimed, and at least 50,000 acres more will be greatly enhanced in productiveness and value.

The sight of this ponderous machine, ploughing its way down through the country where not even a small ditch before existed, excites the graatest curiosity among the natives, and they gather by hundreds along the banks of the new-made stream to witness the wonderful workings of the great steam dredge.

Contaminated Drinking Water

Contaminated drinking water is the cause of so much sickness that every man and woman grown should know good water when they see it, and have the means of testing it. Water may to all appearance be clear and sparkling, and yet contain the germs of foul diseases. The presence of chlorine tells the story. This substance is never found in the soil, and when discovered in water, must have come from the human system. In our daily food we use salt—the chloride of sodium. After passing from the human body it becomes separated, and the chlorine makes its appearance in the contaminated water. As much as thirty or forty grains to the gallon is often found in water drawn from wells near where people live. Let it be understood—the more chlorine in the water the more danger, and, also, that no water is really fit to drink which has any of this foreign substance. This is not a pleasant subject to discuss, but people who are too dainty to pay any attention to it, endanger their health and that of the community they live in.—*Iron Review.*

THE diameter of the sun is 770,800 geographical miles, or 112 times greater than the diameter of the earth; the volume is 1,407,124 times that of the earth, and 600 times greater than all the planets together. Its mass is 359,551 times greater than the earth, and 738 times greater than all the other planets. A single spot seen upon its surface has been estimated to extend over 77,000 miles of space in diameter, and a cluster of spots have been estimated to include an area of 3,780,000 miles.

NEW ORDNANCE MATERIAL*

Official Report to the U. S. War Department.

BY WM. H BIXBY, CAPT. OF ENG'S., U. S. ARMY.

(*Continued from page 261.*)

Service of the Gun.

Gun Carriage.—As the gun was attached by its muzzle to the front plate, and the recoil was not appreciable, the gun carriage was only necessary for supporting the rear of the gun and for permitting the gun's rapid service. It consisted simply of two narrow but high side-plates, connected together by cross-bars, and containing each a vertical slot to serve as a guide, for the gun's movable steel trunnion beds. The gun was raised or lowered by hand by means of a spoke-wheel, and cog-wheels transmitting the motion to two pairs of long screws, each pair passing entirely through the trunnion beds and embracing the trunnions.

To allow of horizontal motion, the carriage rested on two grooved-wheels, running on a horizontal circular single-rail track; it was moved by hand power and cog-wheel mechanism which multiplied the power about 350 times.

Counterpoise Machinery.—The counterpoise machinery consisted simply of a windlass, over or around whose axle passed a chain attached to the counterpoise, connecting it, if necessary, to the exterior mantelet.

Serving and Pointing of Guns.—The service of the gun required thus but four men; one to command and point; a second to traverse the gun; a third to give the elevation; and a fourth to manoeuvre the counterpoise. Owing to the absence of recoil all four men were able to remain continually at their posts, thus facilitating greatly the service of the gun and the rapidity of fire.

The field of fire was (June, 1878), 45 degrees in traverse, and 20 degrees in elevation. The gun could be traversed 45 degrees in about 1 minute.

In order to produce a constant firm though not great pressure of the ball-head upon the socket-piece, the carriage sides were inclined a little backward and upward, and were left free to rotate about the axis of their supporting rollers, and that of the trunnions of the gun. To fix the carriage, if necessary, more rigidly in place, the proposed Krupp model of 1879 provides, in the iron floor of the casemate, a long slot parallel to and just behind the truck rail; a long bolt passing through the carriage bed and the slot can be tightened at any moment by the man at the traversing-wheel, so as to prevent all further horizontal motion of the carriage.

Aiming, Accuracy of Fire.—Several different methods of aiming the gun-casemate gun have been tried; all of them have been very successful as far as accuracy of fire was concerned; the object of all late modifications has been to combine with this a rapidity of aim, and to facilitate the finding and following of any stationary or moving object.

At first (September, 1876, to November 1877) the sighting was done before loading by the aid of a hollow cylinder about 1 meter (39 inches) long, inserted in the bore of the gun at its breech. This cylinder was of the same diameter as the bore of the gun; it had at its front end a fixed sight, and at its rear a movable eye-piece; by the latter the necessary elevation and allowances for drift could be given to the piece.

With the 8-c. m. (3.2-inch) gun (experiments of September, 1876), 60 shots were fired in 15 minutes at a target at 1,521 meters (5,000 feet) distance; the first shot was aimed through the bore of the gun, the others were fired without derangi ng he piece. The shots were all found afterwards to have struck the target within a rectangle of 3.95 meters (13 feet) in height and 2.20 meters (7.2 feet) width; the mean error was 0.81 meters (2.7 feet) in vertical, and 0.51 meters (1.7 feet) in horizontal fire.

Other shots were fired (November, 1877,) at two targets 30 meters (98 feet) apart and at 550 meters (1,804 feet) range, using a similar sighting apparatus. The aiming was easily done, and the fire proved to be very accurate; neither the shock of striking shots upon the front plate, nor the discharge of the gun-casement gun itself, appeared to produce any effect upon the accuracy of the fire.

However, with this cylinder sighting apparatus, about a half a minute elapsed between the aiming and firing (that is to say, the loading required half a minute) during which time any moving object might considerably change

*Published in ENGINEERING NEWS by permission of the War Department.

its place, moreover this method of aiming was rendered difficult by the smoke inside the bore, as well as by that issuing from the breech, or mouth piece; finally, the field of view was very limited.

In June,1878, Mr. Krupp added a pair of fixed graduated arcs, one horizontal the other vertical, on which movable pointers attached to the carriage showed the direction and elevation of the gun. The first shot was then aimed through the bore of the gun as before, and the position of the pointers on the arcs was noted down; all subsequent shots were aimed by the aid solely of the pointers, whose positions were suitably corrected according to the observed inaccuracies of fire.

With these arrangements (June 28, 1878) and with the 15.5-c.m. (6.1-inch) gun weighing 3.6 tons, 20 shots were fired against a target at 592 meters (1,942 feet) distance. The first ten were marked after each shot; they were all contained within a rectangle 1.0 meters (3.3 feet) by 0.75 meters (2.5 feet). The second ten were fired at half-minute intervals and were marked at the end of the 5 minutes fire; they all struck the target within a rectangle of 0.40 meters (15.8 inches) high, and 0.35 meters (13.7 inches) broad. (See Plate 1, Figs. 1 and 2). Next, the firing was recommenced but directed successively upon two different targets at different ranges; the first target was at 595 meters (1,492 feet) distance; the second target was at 564 meters (1,850 feet) distance; and the two were 40 meters (131 feet) apart; 45 shots were to be fired, changing each time the direction or elevation, or both; the first shot was to strike the upper half of the first target at 592 meters (1,942 feet) distance; the second shot, the upper half of the second target placed at 564 meters (1,850 feet) distance; and the third shot, the lower half of this same target; the fourth shot was to strike in the same spot as the first; the fifth as the second; and so on till all were fired. The first shots were aimed through the bore of the gun; the remaining shots were aimed by means of the pointers and graduated arcs.

The 45 shots were all fired in 18.5 minutes, and all struck the respective targets (see Plate 1, Figs. 3 and 4); the average deviation was 11.8-c.m. (4.64 inches) vertically, and 17.2-c.m. (6.77 inches) horizontally; and each group of shots was contained inside a rectangle less than 1.0 meters (39.4 inches) wide, and 0.75 meters (24.6 inches) high. According to the Krupp official report, the first group lay inside of a rectangle 60-c.m. (24 inches) height, and 95-c.m. (38 inches) width; the second group 60-c.m. (24 inches) height, and 75-c.m. (30 inches) width; the third group 40-c.m. (16 inches) height, and 65-c.m. (26 inches) width. The firing was then terminated by 51 shots at 564 meters (1,850 feet) range, in the endeavor to cut a cross upon the target; the rapidity of fire was equal to that of preceeding trials and the result was as successful as could have been expected.

The above results, although remarkable as to accuracy, were not yet satisfactory as to finding for the first time, or following any object shot at; and later on, it was decided to pierce in the front plate and above the guns. a peep-hole of the form of a double truncated cone, whose throat was just above the center of the ball-head.

In this peep-hole was placed a pivoting bar about one meter (3.28 feet) long, turning about a ball and socket joint at the throat of the peep-hole, and arranged to always remain parallel to the axis of the gun; at its front end was a sight fixed to the pivoting ball; and at its rear a movable eye-piece, allowing the pointsman to make the proper correction for drift and for error in elevation.

Owing to the absence of recoil, the pointsman could always remain at the pointing bar, and fire the gun himself, even sitting upon it during the fire (as now proposed by its constructor); in this way the gun could be fired with almost the same ease and accuracy as an infantry sharpshooter's rifle.

Later, another modification was introduced; the vertical arc and its pointer was replaced by a small graduated circle, using a pointer not attached directly to the gun, but driven by cogs, geared into the long screws that passed through and raised the trunnion bed: the latter arrangement allowed the pointer to be placed directly in front of the eyes of the man at the elevation-wheel, (see drawings of the Austrian "Construction-Details.") This indicator indicated each fortieth of a degree.

The graduated arc, used to indicate the position of the gun in traverse, indicated thousandths and half-thousanths of the arc described by its radius.

Further experiments as to rapidity and accuracy of fire were conducted at Meppen in August, 1879, at varving ranges of about 1,500 meter (4,921 feet), 2,000 meters (6,562 feet,) and 3,300 meters (10,820 feet. At 1,500 meters range, the weight of the shot was 35.0 kilograms (78 pounds); at the other ranges loaded projectiles were used, and the weight of the shot was 39.5 kilograms (87 pounds.) At all ranges the charge was 6.5 kilograms (14.3 pounds) of 7-channelled prismatic powder. The first shot was fired at the target at 1,500 meters at (4.921 feet) distance; the second into the ground at the left of the target, with elevation corresponding to about 2,000 meters (6,562) feet; for the third the direction was again changed, and the elevation was arranged for about 3,300 meters (10,820) feet; the fourth shot was then aimed at the target; the fifth in the path of the second; and so on until 35 shots were fired. The first five shots were sighting shots and were aimed by using the peep-hole sight; the rest were fired rapidly at intervals of from 22 to 28 seconds and were aimed by using the graduated elevation and traverse arcs.

The results obtained were:

	FRENCH MEASURES			ENGLISH MEASURES.		
	1st Range.	2d Range.	3d Range.	1st Range.	2nd Range.	3d Range.
Range.....	1,549m.	2,603m.	3.355m.	5, 082 feet	6,770 feet	11,015 feet
Angle of fire.....	2° 48 feet	3° 40 feet	6° 52 feet	2° 48 feet	3° 40 feet	6° 52
Point of mean impact.....	meters	meters	meters			
" below target.....	0. 88			34 inches		
" at its left.....	0.145	0.867	83.7	6 inches	34 inches	33 inches
Horizontal dispersion.....	1. 80	3.9	6. 0	5.9 feet	12.8 feet	19.7 feet
Vertical dispersion.....	1. 70			67 feet		
Dispersion in range.....	45. 0	85.0	52.0	148 feet	279 feet	171 feet
Horizontal mean error...	0.433	1.1	1. 7	17 inches	43 inches	67 inches
Vertical mean error.....	0. 54			21 inches		
Mean error in range.....	14. 6	31.4	11.4	48 feet	103 feet	37 feet

(N. B. The wind was blowing across the range with a velocity of 4.16 meters per second.)

Loading.—The loading, at the Krupp trials, was done by hand and followed the same routine as with any other Krupp breech-loading gun of the same caliber.

Charges, Velocity and Penetration.—The 8-c.m. (3.2-inch) caliber gun (September 1876), fired a 6.8 kilogram (15.0 pound) projectile with 1.5 kilograms (3.3 pounds) charge of prismatic powder.

The 15.5-c.m. (6.1-inch) caliber gun (26th June, 1878), and May 1879, fired weighted shot, 2.8 calibers length, 39.5 kilograms (87.1 pounds) weight with 6.5 kilograms (14.3 pounds) 7-channeled prismatic powder.

The latter should theoretically give about 480 meters (1,756) feet initial velocity, and should enable the shot to penetrate 21-c.m. (8.0) inches of single wrought-iron plate at its muzzle, or about 13.0-c.m. (5,0) inches at 2,000 meters (6.562. feet.

Recoil, Noise, and Smoke inside the Casement.—The accuracy of shooting, as just shown, proves the recoil of the piece during fire to have been so slight as to almost be inappreciable; it was even stated by Krupp's engineers that copper coins placed upon the piece by some of the foreign officers present were not even shaken off its rounded upper surface during its fire. Major Geldern-Egmond expressly states that he was within the casemate, not only while its piece was fired, but also while the casemate was being fired upon (in the experiments of November, 1877); and that "the shock of outside projectiles against the front plate produced only a slight vibration of the soil, and a noise comparable to that of a hammer, striking upon its anvil; that the fire of the piece was not annoying, and that the cannon did not move."

As regards the smoke, none could enter the casemate except that which escaped from the breech of the gun during loading; smoke thus escaping from the gun, actually proved somewhat annoying at the Meppen trials in November, 1887; however, this was more due to the lack of any ventilator in the experimental casemate, than to a faulty construction of the gun.

Time of Construction and Cost.—At the time of the writers visit to Essen, Mr. Krupp, through his agents, was not willing to give any details as to cost of these guns, or time needed for their manufacture. No printed documents giving such details have as yet been found.

The whole casemate (1877 trials) contained 104 tons of cast and wrought-iron; and could scarcely have averaged over $200 per ton, or $20,000 in all, for both casement and gun mounted in place. The guns alone would probably cost from $5,000 for the 6-inch, up to $8,000 for the 8-inch caliber; small orders might be filled in a year and a half, and large orders in a year.

TO BE CONTINUED.

Foundation of the Fourteen-foot Bank Light-House in Delaware Bay.

The Fourteen-foot Bank is a somewhat dangerous sand-bar in the lower end of Delaware Bay. It is in a very exposed position; from the southeast the seas of the Atlantic have full play; to the northwest there is an open stretch of 75 miles of water; to the east of the bar are 25 miles of water, and westward, the nearest land is 12 miles distant.

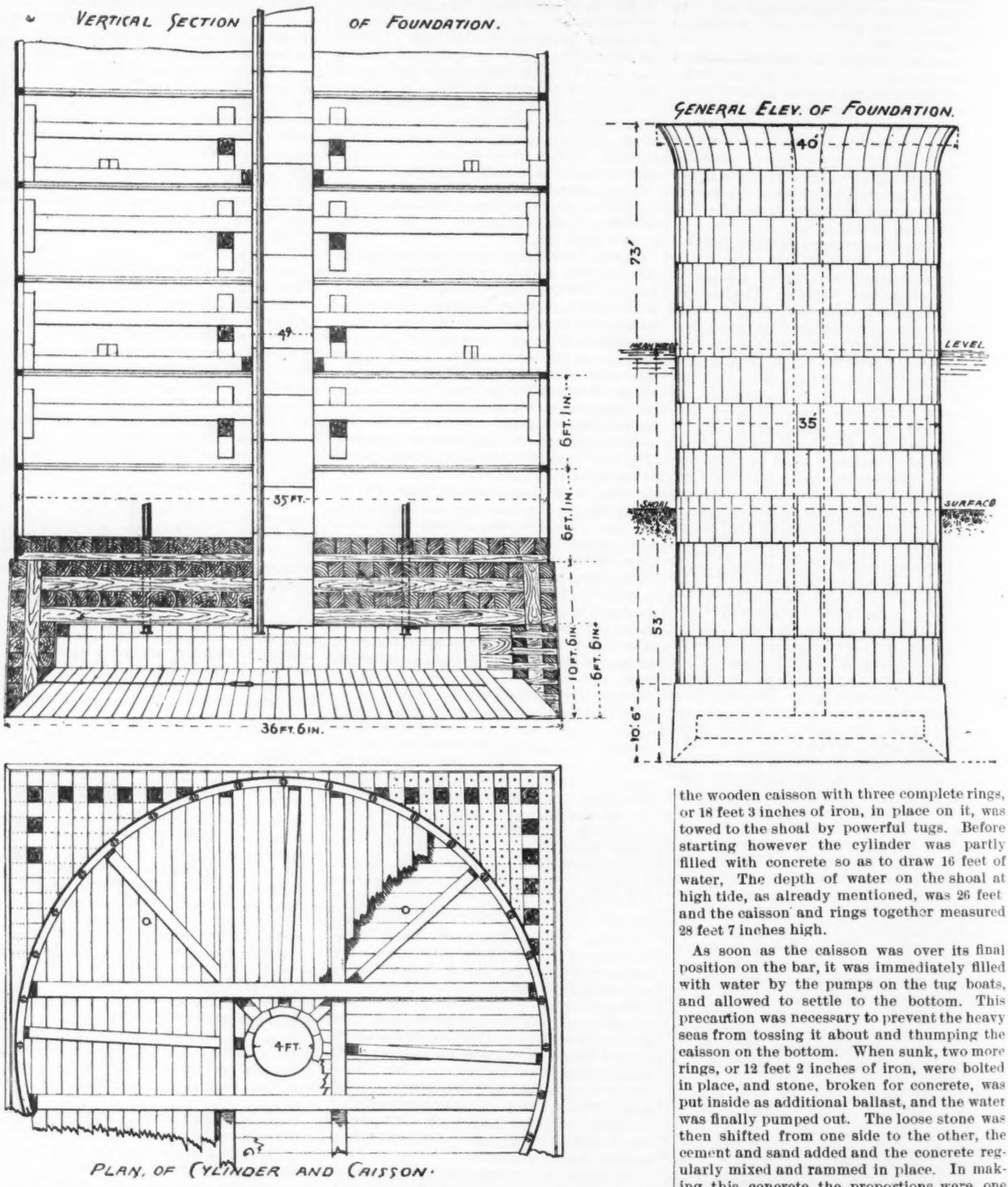
Under these circumstances the sea at this bar was always more or less heavy and frequently dangerous, and any constructive work was attended with difficulty. The bar itself was compact sand and gravel, and, at high tide, had 26 feet of water over it at the site of the proposed light-house. Various plans were suggested for securing the desired foundation, among these the towing of a caisson into position by enormous camels, or floats.

In the early part of this year proposals were advertised for by the Fifth Light-house District, and the successful bidder was the firm of Anderson & Barr, of New York, the work to be done upon plans submitted with their proposal.

The general design is shown in the illustration; in plan the foundation was first a wooden caisson 36½ feet square and 10½ feet deep, then a circular cast-iron shell, 35 feet in diameter filled with concrete, and terminating in a bell-top 6 feet 1 inch high and 40 feet in diameter. The cutting-edge of the caisson as sunk was 53 feet below mean tide, or about 34 feet below the surface of the shoal. The total height from cutting-edge to top of the iron bell was 83 feet 6 inches.

The caisson differed little in its construction from similar structures; it was made unusually tight against air and water pressure by the

DETAILS OF FOUNDATION: FOURTEEN-FOOT BANK LIGHT-HOUSE DELAWARE BAY.



use of tongue and grooved flooring and layers of tarred roofing paper placed between the sets of roof timbers. The plan shows the arrangement of timbers, the blowing out pipes and the working shaft of 4 feet diameter.

The cast-iron shell was provided by the government. The main plates were 6 feet 1 inch high, 1¼ inches thick, and in width spanned an angle of 10° with a radius of 17½ feet. The flanges, which surrounded the plates on four sides, were 1¾ inches thick and 6 inches deep from out to out. The bottom section, or tier of plates, had a lip 1½ inches deep, setting into the timber of the caisson. The bolt-holes were 1⅛ inches in diameter and were spaced, vertically, five to a plate 6 feet 1 inches high, and horizontally four to a normal plate width. The bell-top of the foundation cylinder was 1½ inches thick and curved to a radius of 7 feet 5 13/16 inches; it was provided with several openings called "cellar-windows," mooring-rings, etc.

Work was commenced by the contractors on May 25, 1885, at Lewes, Del., about 20 miles from the site of the proposed light-house. About July 1st the hull of an old steamboat, 300 feet long and 38 feet beam, was towed to the spot and well secured by six heavy anchors. On this boat was all the air-compressing plant, the quarters for the men, pumps, supplies of material and a boom-derrick with a reach of 40 feet. On July 5th, the wooden caisson with three complete rings, or 18 feet 3 inches of iron, in place on it, was towed to the shoal by powerful tugs. Before starting however the cylinder was partly filled with concrete so as to draw 16 feet of water, The depth of water on the shoal at high tide, as already mentioned, was 26 feet and the caisson and rings together measured 28 feet 7 inches high.

As soon as the caisson was over its final position on the bar, it was immediately filled with water by the pumps on the tug boats, and allowed to settle to the bottom. This precaution was necessary to prevent the heavy seas from tossing it about and thumping the caisson on the bottom. When sunk, two more rings, or 12 feet 2 inches of iron, were bolted in place, and stone, broken for concrete, was put inside as additional ballast, and the water was finally pumped out. The loose stone was then shifted from one side to the other, the cement and sand added and the concrete regularly mixed and rammed in place. In making this concrete the proportions were, one part Alsen's Portland cement, two parts sand and three parts broken stone. More concrete was then mixed on the deck of the large hulk before referred to, and transferred into the caisson by the large derrick.

As soon as sufficient concrete was in place to overcome all flotation in the structure and resist the lifting effect of the air-pressure, the water in the working chamber was expelled by compressed air. This work was commenced on July 24th. At this time the sand under the action of the tidal currents and waves had scoured out from under the cutting edge to the extent of from 5 to 10 feet, at certain points and the caisson was out of level 6 ft. in its width. After the men got to work the in-

side of the caisson was levelled by cutting out under the high sides and the structure sunk to a depth of 18 feet, the sand being discharged into the iron shell to serve as a counter-balance to the increasd upward pressure. Sinking was then stopped, the air pressure removed, and the sand taken out and replaced by concrete. Iron rings had of course been added as the caisson sunk. On August 17th, the air-pressure was put on again and the caisson settled still further until, on August 28th, the cutting-edge had reached the deepest point considered necessary, the iron-work was then carried up to the required height and completed on September 16th.

During the time of sinking the caisson, several days had been lost by stormy weather; at one time the mooring of the hulk had been broken and the supply vessels had frequently been driven away by bad seas. The inside bracing of timber shown inside the iron shell, was not used in fact, as the cylinder was stiff enough without it. The hulk usually lay alongside the cylinder separated by a spring fender fastened to the sides of the hulk.

This work was done under Major D. P. Heap, U. S. A., Engineer-Secretary of the Light House Board; the officer in immediate charge was Capt. J. C. Mallery, U. S. Engineers, 5th. Light House District. The cost of these foundations, exclusive of the iron, was $38,900, the iron-work cost about $7000 more. Work was carried on day and night with a force of about 45 men, and the contractors received the highest praise from the government officials for their successful and expeditious work under unusually difficult circumstances.

Local Attraction in Land Surveying.

Written for ENGINEERING NEWS,

BY J. O. BAKER, C. E., PROF. OF CIVIL ENG., UNIVERSITY OF ILLINOIS.

It is very common to hear the remark that the common compass could not be used because of local attraction. It is well known that there are many localities in which the needle is deflected by the attraction of iron, etc; but the object of this article is to show that no matter how much the local deflection, the common compass can be made to give as accurate results as though there was no such disturbing influence.

This method of using the compass seems not to be either understood or practiced by surveyors generally; and this even though the essential features of the method are given, rather obscurely, perhaps, in a book which is very generally used, "Gillespies' Land Surveying," page 143. This is the more surprising when it is known that instead of using the simple compass in this very easy way, the complicated, expensive, and it is believed, less accurate, solar compass has been employed. The much maligned magnetic compass is an instrument capable of much greater precision than it is generally credited with; with the solar campass the case is nearly reversed.

CASE I.—*When only the area is wanted.*—Place the compass at each corner of the field in succession and determine the bearing of the two lines meeting in each station. Call the sight made in the direction in which the surveyer goes around the field a *fore-sight*, and that made in an opposite direction a *back-sight*, keep one end of the box front on fore-sights and the other end front on back-sights; but, if one sight of the compass consists of a slit and the other of a hair, the same end must necessarily be kept next to the eye, therefore read the letters from one end of the needle for fore-sights, and from the opposite end for back-sights, and the degrees from the same end. When all the bearings have been taken, the record will be similar to the first three columns of the following table, with the exception of the small figures written above each bearing which will be explained presently.

Station.	Back Sight.	Fore Sight.	Correction.
N	$S\ 78\ 00\ E$	$N\ 16\ 05\ W$	0
Q	$N\ \frac{16}{16}\ \frac{45}{45}\ W$	$N\ \frac{89}{81}\ \frac{20}{10}\ W$	40′ *F*
S	$N\ \frac{80}{80}\ \frac{30}{05}\ W$	$S\ \frac{48}{46}\ \frac{10}{35}\ W$	25′ *B*
U	$S\ \frac{46}{46}\ \frac{10}{35}\ E$	$S\ \frac{83}{82}\ \frac{00}{35}\ E$	25′ *B*
V	$S\ \frac{83}{82}\ \frac{00}{25}\ E$	$S\ \frac{78}{77}\ \frac{00}{25}\ E$	35′ *B*

Owing to changes in the declination, it is not probable that every fore-sight will agree with its corresponding back-sight. However, if the two bearings at any station have been taken in a short time of each other, the notes may be corrected so as to wholly eliminate the effect of any change of the needle.

Since the assumption is that only the area is required, it is immaterial where we commence to correct the angles. Therefore we may assume the bearings taken at any station, say *N*, are correct. The back-sight from the next station, say *Q*, (it is immaterial whether the angles are connected in the order in which they were surveyed or not), differs from the fore-sight from *N* by 40′, therfore the bearings at *Q* are in errror 40′, to correct which we may conceive that the needle should be moved 40′ in a direction from the north toward the east, i. e., in the direction in which the hands of a watch move. It makes no difference, in this matter, whether we consider *N*, *E*, *S* and *W* in their true relations or in their reversed position, as given by the face of the compass. We will assume them to be in their true relations; and briefly say that the correction at *Q* is 40′ forward. This is the correction which is to be applied to the fore-sight at *Q*, and is written in the column headed "correction." The corrected fore-sight from *Q* is 80° 30′; the back-sight from *S* should agree with this, but there is a difference of 25′. Therefore the correction at *S* is 25′ backward; and the corrected fore-sight is 46° 10′. The corrections and corrected angles for the other stations are formed in a similar manner, and the corrected bearings written above the observed value, as in the table.

The agreement of the last corrected fore-sight with the first corrected back-sight is a valuable check on the accuracy of the work, as a rule, this difference should not exceed five or ten minutes.

CASE II *When the area and also the true bearings are desired.*—The case requires one of two things, either 1: That several successive back-sights shall agree with their corresponding fore-sight before either have been connected; or 2, that there shall be a true meridian which can be connected with a corner of the field by lines whose bearings are to be found as those of the boundary lines. In the first instance, it may safely be assumed that, since a number of the fore-sights and back-sights agree, there has been no change in the middle between those stations; therefore the observed bearings may be assumed to be the true bearings. Having some of the correct bearings, if there are any stations at which the back-sight and fore-sights do not agree, they may be corrected as in Case I.

If the declination is not set off on the compass, it may be applied as a correction to those stations at which the back and fore-sights corresponded as above, and the correction carried on to those stations at which a difference was found.

In the second instance as above, the true bearings of the several lines can be found in succession beginning at the meridian. The following example will illustrate this method *Z* is not a corner of the field but a point on a known meridian; the line *Z Q* is run to deter mine the declination at *Q*, a corner of the field, All of the remaining stations are corners of the field.

Stations.	Back Sights.	Fore Sights.	Corrections.
Z	$N\ \frac{0}{3°}\ \frac{00}{50}\ W$	$N\ \frac{13}{69}\ \frac{10}{20}\ E$	3° 50′ F
Q	$N\ \frac{73}{69}\ \frac{10}{15}\ E$		3° 55 F
Q	$N\ \frac{14}{10}\ \frac{40}{45}\ E$	$S\ \frac{83}{89}\ \frac{40}{45}\ W$	
T	$S\ \frac{83}{89}\ \frac{40}{35}\ W$	$S\ \frac{43}{39}\ \frac{5}{00}\ W$	4° 05 F
U	$S\ \frac{43}{39}\ \frac{5}{10}\ W$	$N\ \frac{14}{10}\ \frac{45}{40}\ E$	3° 55 F

Notice that the first two lines of the above record are preliminary to the survey of the field, and are required only to find the declination at *Q*. Having found the declination or correction at *Q*, the bearings are corrected as in the previous case. The back-sight from *Q* to *U* 5′ from the fore-sight at *U* to Q, which shows that there was an error or inaccuracy of 5′ in reading the angles.

Undoubtedly the method of correcting with a meridian as just explained, is more exact than the previous method, although the latter is more convenient and shorter and is the one which will generally be used in practice. However if the bearings show local attraction at a number of stations the first method of Case II cannot be applied while the second will give strictly correct results whatever the number of stations at which local attraction exists or whatever its amount.

The back-sights should always be taken, although it may be nearly certain that no local attraction exists, for this is a check against possible local deflection of the needle, and also against errors in reading the needle.

SOURCES OF ERROR.—The error of, compass work may be grouped in one of the following classes: 1st. Instrumental errors. 2nd. Instrument or flag-pole not being set at the right place. 3rd. Errors of chaining. The first have been discussed already.† The second are small and easily remedied. The flag-pole should be set vertical; but, as a precaution, sight as low on it as possible.

The instrumental errors are due either to lack of adjustment, or to errors in the practice. In using any instrument, it is a good rule to adjust it carefully in all particulars and then use it in such a way as to eliminate any residual errors of adjustment, or, in other words, adjust it carefully and then use it as though it were not adjusted. In using a compass, guard against errors of coincidence of magnetic and geometrical axes of the needle, and also of straightness of needle, by reading always the same end of the needle. Sighting nearly horizontal will reduce the possibility of error due to lack of perfectness in the adjustment of the levels.

To guard against the possibility (1) That the magnetic axis of the needle may not coincide with its geometric axis. (2) That the zero of the vernier may not coincide with the line of sight, and (3,) errors in straightness of the needle determine the declination by setting the compass upon a true meridian, sighting along it, and then moving the vernier until the needle reads zero. This also provides against errors in charts or tables giving the declination, and also against changes in the declination since the chart was made. This observation should be made about 10 A. M., or 6 P. M., as then the effect of the daily variation is nearly zero.

It is very important that the three sources of error just mentioned should be eliminated. For one of these reasons the bearing of a line as read by several instruments at the same time and place, and by the same person will often differ 10 to 15 minutes. For an example of five instruments which differed 20 minutes, see the Fifth Annual Report of the Ohio Society of Surveyors and Civil Engineers, page 71; the same page gives an account of four instruments which differed 31 minutes. Notice that these instruments were read at the same

†ENGINEERING NEWS, Sep. 15, 1885.

time and place, but by different men. On page 74 of the above report, is an account of six needles, made as nearly alike as possible; specially for the purpose, read under identically the same conditions in every respect, which differed ten minutes. In all work in which the location of a line is to be determined by its recorded bearing, the above precaution is exceedingly important.

The writer believes that we shall never be able to follow all the eccentricities of the variation of the declination, but he also believes that the method of using the compass here advocated, together with the precautions mentioned above, is practically independent of all such variations.

The most common error in the practice is reading N. for S., etc., and 28° for 32°, etc. The only check or remedy is carefulness. After the needle has come to rest, it should be tapped gently to destroy the effect of any adhesion to the pivot.

LIMITS OF PRECISION.—The error of taking a bearing is made up of the error of sighting, of sluggishness of the needle, and error of reading the needle. The last is the greatest. With a compass graduated to half degree, the angles can be estimated to the nearest five minutes, in which the maximum error of a bearing should not exceed ten minutes. The average probable error of a bearing for a class of ten, as deduced from the error in closing the angles around a field, was 1.64 minutes. That the average probable error is 1.6 minutes show that bearings can be read certainly to the nearest five minutes. For the purpose of this record, the same men read the bearing of a flag-pole at one, two and three hundred paces, with probable errors of $2\frac{1}{2}$, $3\frac{1}{3}$ and $3\frac{1}{2}$ minutes respectively, the sun and wind being in the observer's face while sighting. This would seem to indicate that, under favorable circumstances, the probable error of a bearing should be less than two minutes, and under unfavorable conditions it may be more than three minutes. The angular error of closing a field is equal to the square root of twice the number of the sides, multiplied by the error of a single bearing.

The error of an area found by compass surveying is made up of the error of chaining, of reading the bearings, and of computations. Land surveyors in actual practice, find that the chaining as ordinarily done is much the greatest source of error. With proper care the error of chaining should be much less than the error of the bearings. Since one in fifty-seven × corresponds to 1°, the above maximum error of 10 minutes corresponds to an error of one in three hundred and forty-four, and the probable error of 1.64 corresponds to one in two thousand, which is greater than that of chaining under the same conditions. Since the computations are self-checking at every step, there is little probability of any blunder in this part of the work; and as the work may be carried to any desired number of decimals, the inaccuracies of the computations can be made much less than those of the field work; therefore we conclude that the accuracy of the area depends mainly upon the accuracy of reading the needle. An area found by compass surveying should be true to within three or four thousand.

BALANCING THE WORK.—When the angles are measured as above, an answer can be given to the question, which is frequently asked, viz:—How great a difference between the sums of the + and — latitude and departure is admissible?

Let C = the linear error of closing due to the chaining; C is equal to the perimeter of the field ($= P$) divided by the distance ($= d$) in which the error of chaining is a unit, that is

$$C = \frac{P}{d}.$$

Let A = the linear error due to the measurement of the angles. The difference between the last fore-sight and the first back-sight is the angular error of measuring the angles; we will assume this difference to be in minutes and represent it by a. It cannot be known how this error occurred; whether it occurred all in one sight, whether it occurred equally among the sides, or among the sides in proportion to their length. But, as the last is most probable, and also as it gains the largest linear error in closing, we will assume the error a to have occurred among the sides in proportion to their lengths. Hence to reduce a to its linear equivalent, we must multiply it by the length of the perimeter ($= P$) and divide it by the distance at which a unit subtends an angle of one minute, or

$$A = a\frac{P}{3438} = \frac{3\,a\,P}{10{,}000} \text{ nearly.}$$

Let E = the total error, *i. e.* the error due to chaining and measuring the angles. Notice that the actual error E, is the hypothenuse of a right angled triangle of which the differences of the latitudes and departures are the other sides. Hence, if L = the difference of the + and — latitudes, and D = the same for the departures, $E = \sqrt{D^2 + L^2}$.

By the theory of probabilities, we know that

$$E = \sqrt{A^2 + C^2} = \sqrt{\left(\frac{P}{d}\right)^2 + \left(\frac{P\,a}{3438}\right)^2} =$$

$$P\sqrt{\left(\frac{1}{d^2} + \frac{a^2}{12000000}\right)} \text{ nearly.}$$

Equating these two values of E, we get

$$D^2 + L^2 = P^2\left(\frac{1}{a^2} + \frac{a^2}{12000000}\right)$$

We may simplify the matter a little further by finding a relation between D and L. Assume that the sum of the latitude $= n$ times the sum of the departures, n is easily determined from the computations, or it can be estimated in the field or from the plot with sufficient accuracy. From the theory of probabilities, we know that $L = \sqrt{n}\,D$, then the above formula becomes

$$D^2 + L^2 = (1+n)\,D^2 = P^2\left(\frac{1}{a^2} + \frac{a^2}{12000000}\right)$$

To illustrate the method of applying this let us assume, that, in surveying a field whose perimeter is ten chains the difference between the first back-sight and the last fore-sight was 10′; we will also assume that the conditions were such that we might expect an error of 1 in 2000 in chaining. The above formula then becomes,

$$D^2 + L = 10^2\left[\left(\frac{1}{2000}\right)^2 + \frac{10^2}{12000000}\right] = \frac{1}{40000} +$$

$\frac{1}{1200} = .00086$, or $(1+n)\,D^2 = P^2\left(\frac{1}{a^2} + \frac{a^2}{12000000}\right)$ $= .00086$ chains.

If the field is twice as long north and south as east and west, then $n = 2$, and $D = .017$ chains or 1.7 links. This shows that the error in the departures should be about 1.7 links. The error in the latitudes should be $1.7\sqrt{n} = 1.7\sqrt{2} = 2.4$ links. Results much greater than these show an error in the work other than the usual inaccuracy.

Finally, by reversing the problem, knowing the error of closing the angle, and the errors in balancing the latitudes and departures, we may reverse the above formulæ and compute the error of chaining.

The writer does not wish to be understood as advocating that the compass is the best instrument for land surveying, or that it is sufficiently exact; he only wishes to call attention to a better method of using an instrument that is not without merits, but which can never become an instrument of the highest precision.

Submarine Explosions.

In connection with the late exhibition of the power of explosive compounds at Flood Rock, a brief description of the methods adopted in testing the efficiency of submarine mining powders may be of interest to our readers.

The material used in this sketch is derived from the report of Gen. Henry L. Abbot on "Experiments and Investigations in developing a System of Submarine Mines for defending the harbors of the United States;" it was published as No. 23 of the Professional Papers of the Engineer Corps of the U. S. A. Gen. Abbot himself has been engaged in testing all the explosives used at the Hell Gate Improvement, and the apparatus to be described was employed in that connection.

In testing the efficiency of torpedoes against war-ships, doubtless, the simplest, most practical and satisfactory conclusions could be arrived at by exploding them against the sides of an actual modern war-vessel. But as the United States had none of her own available and could not borrow from foreign nations for such purpose, it became necessary to devise some other method.

The first requirement was a device for precisely measuring and recording the force transmitted through the fluid, and in this way establish a basis by which the relative merits of different explosives could be compared. The pressure-gauge, suggested by Maj. W. Wade and devised by General Rodman in 1851, was practically adopted for this purpose, but with material improvements and changes. General Rodman used a hollow cylinder of iron, and an indenting tool acting upon a piece of copper to measure the intensity of the explosive force of gunpowder burned in a cannon. In 1869, Capt. Wm. H. Noble, of the Royal Artillery, substituted for the indenting tool a small copper cylinder to be compressed in the direction of its length by a movable piston; this was called the "Crusher Gauge." To determine the pressure and form a scale for interpreting the mechanical work done by the powder, similar copper cylinders were at first subjected to the action of a testing machine, in which, by a slow motion, the specimen was compressed by known forces. But in 1865, Prof. Wm. H. Bartlett, of the U. S. Military Academy, criticised this method of comparing results, upon the ground that it ignored "the distinction between the measure for *intensity* and that for its *work*."

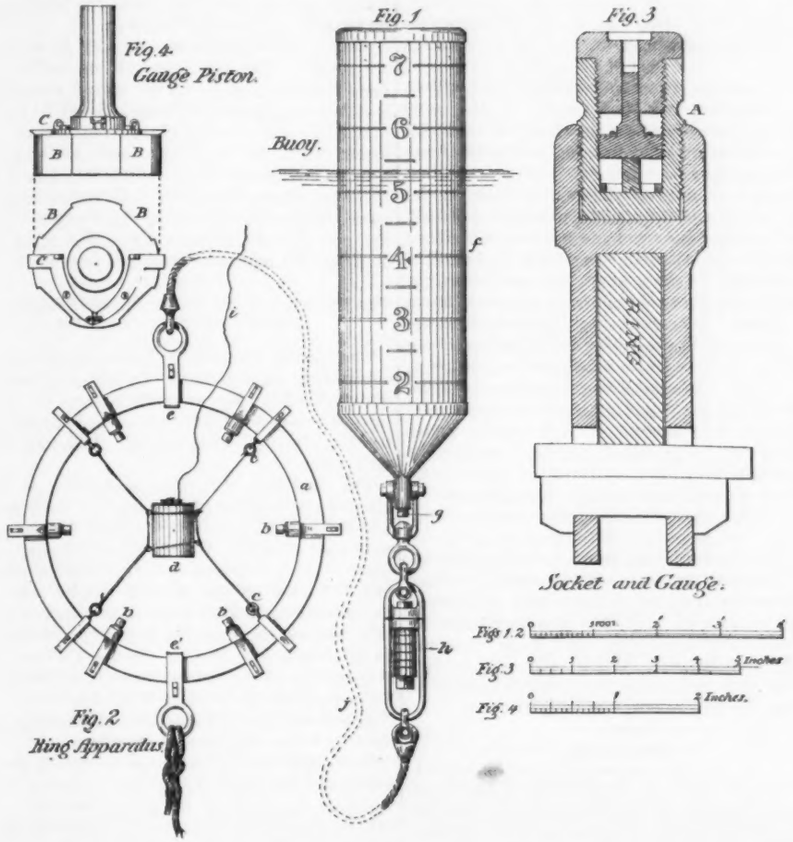
The real difficulty, however, seemed to lie in the ignorance of the laws which connect the intensity of copper resistance and of gas elasticity with the plug penetration. In 1869, General Abbot, as executive officer of the Board of Engineers, was called upon to prepare a dynamometer for measuring the force of sub-aqueous explosions, equal in power to the destruction of large vessels; and while the general method above indicated, seemed the most feasible plan, two difficulties presented themselves, one mechanical, the other mathematical.

The mechanical troubles were to exclude the water, or neutralize its effects, when the Rodman gauge was submerged to, say, 100 feet; to prevent the hammering motion of the piston, which occasioned the secondary cuts observed by Major King, and to increase the delicacy of the record, so that the apparatus would register much smaller intensities of action than those developed in the bore of a cannon.

The mathematical problem consisted in deducing from the mechanical work done by the explosion, as registered by the apparatus, a correct knowledge of the destructive power developed.

The mechanical difficulties were overcome as shown in Fig. 3. The water is excluded by a stout rubber cap held in place by a rubber band fitting in the groove A; and should any accidental leak occur, its effect was neutralized

by cutting the base of the piston by four planes (*B* Fig. 4) parallel to the axis, so as to allow the water to pass freely around it. To prevent hammering of the piston, a clutch (*C*) was attached to its base in such manner that the piston could pass freely downward, but is effectually prevented from returning by the clutch (*C*) engaging in the screw threads in the interior of the cylinder. To secure the requisite sensitiveness, cylinders of lead were employed to register the work of explosion as transmitted. To further extend the scale, three different sizes of piston were adopted, having sectional areas of 0.100, 0.385 and 0.785 square inches. Since 1872 the No. 2, or intermediate size, has been abandoned.



Apparatus used in Testing Submarine Explosives at Willet's Point, Long Island

The lead cylinders were all made at one time, for an extended series of experiments, from carefully selected original manufacturer's pig. They were formed by casting and compression, a small hole being left in the die to allow the surplus lead to escape. Five sizes of these cylindrical leads were adopted and designated for convenience by their diameters, as follows:—

$\frac{75}{100}$	Lead; length,	1.006	inches; diameter,	0.75	inches.
$\frac{6}{10}$	" "	1.004	" "	0.60	"
$\frac{5}{10}$	" "	1.003	" "	0.50	"
$\frac{4}{10}$	" "	0.799	" "	0.40	"
$\frac{3}{10}$	" "	0.601	" "	0.30	"

To measure the compression in these cylinders, use was made of a standard scale, with one fixed and a sliding contact piece, reading by a vernier to one-thousandth of an inch.

The interpretation of the lead compression induced by an explosion required careful consideration. Without entering into the subject as deeply as has Gen. Abbot in his report, we will simply outline his line of investigation and the results. In the course of his experiments, made at Rock Island Arsenal, General Abbot satisfied himself that in using lead cylinders, a marked variation occurred by the shortening, or varying the time of applying the pressure, or by continuing it. This was a difficulty that could not be avoided so its law had to bestudied so that corrections could be made.

As illustrating the effect of time, we take from a long table published, the behavior of a $\frac{3}{10}$ inch lead cylinder, originally one inch long; 1,000 pounds pressure was applied as rapidly as possible and the shortened length was 0.736 inches; the same weight applied through two minutes reduced the length to 0.567 inches. In the second case the same pressure was reapplied to the same lead and kept steadily on it for the two minutes. To meet this difficulty of time in lead cylinders Gen. Abbott proposed to place several pressure gauges, containing leads of different dimensions, under identical circumstances respecting a subaqueous explosion, and by so doing to obtain exactly *corresponding compressions* due to a given impulse; and by varying the area of the pistons, other corresponding series could be secured, the data thus admitting of many checks and thorough analysis. Acting upon this idea, a careful scale was made with a testing machine, to serve for purposes of preliminary comparison. In this scale the pressures rise, by 100 pounds, from 100 pounds to 4,000 pounds, and the diameters of the leads ran from $\frac{6}{10}$ to $\frac{75}{100}$ inches. At 100 pounds, a $\frac{3}{10}$ lead shortened 0.002 inches; a $\frac{4}{10}$ lead, 0.004 inches; a $\frac{5}{10}$ lead, 0.002 inches, and $\frac{6}{10}$ lead remained intact. At 1,000 pounds, the shortening, taken in the same sequence, was 0.430, 0.431, 0.288, 0.127 in., and for the $\frac{75}{100}$ lead, 0.016 inches. At 2,000 pounds, they ran, 0.486, 0.590, 0.618 0.461 and 0.204. At 4,000 pounds, commencing with the $\frac{3}{10}$ lead, the cylinders shortened, 0.657, 0.762, 0.709 and 0.530.

Actual experiment, however, proved that the relative compressions made by the testing machine—requiring 30 to 60 seconds to effect—bore no simple relation to those produced by sub-aqueous explosions. Special apparatus was then successfully devised to eliminate this time element in reducing a scale, and ratios of interpretation accurately fixed.

With the form of dynamometer thus adopted, the next consideration was to devise an apparatus for holding several of these instruments rigidly in certain known positions with regard to the center of the exploding charge, and at variable but known depths below the surface. This device is shown in the Ring apparatus (Figs. 1 and 2), which is the same in principle as that devised by Major King in 1865. It consisted of a stout wrought iron ring, made strong enough to resist the strains to which it was to be subjected; attachments for the gauges; charge attachment; a buoy and wire connecting rope. Four sizes of rings were used, 3, 4, 5, and 8 feet in diameter. They were made of the best wrought iron in the market, and the first three sizes were $1\frac{1}{2}$ inches thick and $4\frac{1}{2}$ inches wide; the 8-foot ring was only for exceptional purposes and was 1 by $4\frac{1}{2}$ inches, in order to reduce the weight to the supporting power of the buoy designed for 5-feet rings.

The six gauge sockets (Fig. 3) were set in shallow seats cut 60° apart, and were secured by gibs and keys, as shown. The supporting straps (*e*), and attachments (*c*) for the charge of explosive, are sufficiently well illustrated without any further description; they were also secured by gibs and keys. The bottom attachment (*e*) was simply for a guard-rope in case of accident.

The buoy (Fig. 1) was made of $\frac{3}{16}$ inch wrought-iron, it was cylindrical in form, 2 feet in diameter, and 6 feet in height. The bottom cone was 1 foot high, and in it $\frac{1}{4}$ inch iron was used. At its vertex was a gauge-socket, (*g*) and attachment for the wire rope, 1-inch in diameter. The buffer (*h*) shown at the upper end of the rope, was made of five vulcanized rubber rings, each 1-inch thick; this latter appliance was exceedingly useful when heavy charges were used. The displacement of the buoy was 1,300 pounds, and the weight of the buoy, with rope and attachments, was 656 pounds. The 4-foot ring without attachments weighed 301 pounds, the 5-foot ring 381 pounds, and the 3-foot, 231 pounds. The ring attachments, with large gauges, 232 pounds and the small gauges 205 pounds. The scale painted on the side of the buoy is to enable the submergence of the charge to be known.

The six sockets with gauges in them (*b* Fig. 2) were arranged as shown on the ring; in addition another gauge *g* was put in the apex of the buoy, and others still could be arranged between the ring and the buoy. The case of explosive (*d*) to be tested is lashed in the center of the ring by galvanized iron lashings usually, and is fired by electricity.

This is the apparatus used in the government tests. The usual physical phenomena connected with sub-aqueous explosions are interesting as detailed in the report. Sound is deadened to a surprising degree by water over the charge; and one pound of dynamite exploded 3 feet below the surface will produce a locally much louder sound than 500 pounds submerged 20 feet when fired. Fish are peculiarly sensitive to a submarine explosion, and a five pound charge of dynamite will cause Manhaden to leap out of the water at a distance of several hundred yards. A general characteristic of small and deeply sub-merged charges of quick acting explosive mixtures, is, that at the instant of detonation, and before any disturbance of the surface water is visible, three sharp sounds are heard resembling raps on a hard surface. These sounds are not echoes but impulses, and there are really more though the ear fails to detect them. It has been noted that a buoy floating vertically over a large torpedo is always thrown upward in advance of the water jet, and is carried to a much greater height than the spray; and it is also a fact that fragments of a torpedo, unless acted upon by a high wind, always fall within a few feet of the explosion. As regards the dimensions of columns of water thrown into air by the explosion of a torpedo, the following figures give some idea of the height and lateral effect:—100 pound of dynamite No. 1, fired 5 feet under water in water 10 feet deep, will produce a column 340 feet high and 35 feet base-diameter; the same charge submerged 12 feet in water 21 feet deep, will make a column 270 feet high and 60 feet base-diameter; 200 pounds fired in water 19 feet deep, with charge on bottom, will throw a column 81 feet high and 80 feet in bed-diameter, and 500 pounds submerged 13 feet in 20 feet of water produced a column 105 feet high and 100 feet base-diameter. These figures are deduced from instantaneous photographs. From observations taken at the time of the Hallet's Point explosion, in 1876, General Abbot found than in the drift formation of Long Island the explosion of 50,000 pounds of dynamite produced an earth tremor that travelled $13\frac{1}{2}$ miles at the rate of 5,300 feet per second.

Engineering News

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, - - - New York City.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

PUBLISHED EVERY SATURDAY.

CONDUCTED BY

GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.: M.Inst.C.E.

TERMS OF SUBSCRIPTION:

4.00..... .....PER YEAR TO U. S. AND CANADA.
$5.56..... " " " FOREIGN COUNTRIES.

TABLE OF CONTENTS

	PAGE
Tall Chimney Construction	273
A Great Drainage Enterprise in Illinois	274
Contaminated Drinking Water	274
New Ordnance Material	274
Foundation of the Fourteen-foot Bank Lighthouse in Delaware Bay (*Illustrated*)	275
Local Attraction in Land Surveying	277
Submarine Explosions (*Illustrated*)	278
Editorial Notes	280
Flood Rock	280
The Proposed Trial of Automatic Freight car Brakes at Burlington, Iowa	280
British Pounds	281
Cable Transportation at the Mt. Jalla Mines, near Grenoble, France	281
Wells in Sandy Soil	281
German Rules for the Consumption of Water	282
Personals	282
Liverpool Engineering Society	282
Correspondence	282
Breakages of Axles on German Railroads	283
Forth Bridge Railway	283
The Tay Viaduct	283
Surveying Instruments	284
Trials of Water Meters	284
Literature	284
Indo-European Overland Telegraph	284
History and Statistics of American Water-Works	285
Water	285
News of the Week	286
Market Report	288

CLUBBING ARRANGEMENTS.

1886.

The "subscription season" for the most popular American Magazines is close at hand, and inquiries as to our proposed clubbing arrangements are being made. We beg leave to announce, therefore, that on and after JANUARY 1, 1886, the subscription price of ENGINEERING NEWS will be **$5.00** per year: until that date the price and clubbing rates with other publications will remain as given below.

We are now planning such improvements in ENGINEERING NEWS, and negotiating for special work to be done during the coming year, as will cost double any possible increase of income from subscriptions: the long notice of change which we here give enables nearly, if not all, present subscribers to renew at present rates. We intend eventually to publish a class journal which will acknowledge no superior in the world, and we feel so confident of the support of our present patrons that we have no hesitation in venturing on the greatly increased expense necessary to carry out our programme.

If an English engineering journal, carrying fifty pages of advertisements and twenty four of reading matter sells for $10, why may not an American journal of equal merit sell for at least half as much.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals, we offer he following terms until January 1, 1886: We will send to any address ENGINEERING NEWS at regular subscription price, **$4.00** and the following at the additional prices given:

	Net. Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.65	2.00
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
North American Review	4.10	5.00
Cassell's Magazine of Art ,m	3.00	3.50
Cassell's Family Magazine ,m	1.25	1.50

The Century Magazine commences its year with the November Number; Harper's Magazine commences with the December Number. Subscribers should renew these Magazines in October and November.

Subscribers to other publications clubbed with ENGINEERING NEWS, must notify those "other publications" direct, of change of address during the year. After we have transmitted for the year's subscription and had the subscriber's name and address properly entered on he clubbing lists, our connection with the transaction *ceases entirely*. Our margin of five cents on each subscriber does not allow for much extra expense in time and postage and stationary.

ACCORDING to the press reports of that city the intermittent system of the London water supply is to be discontinued, with all its inconveniences, in a part of the Metropolis, at least. The New River Company, which furnishes the whole of the City of London with water, excepting a small portion at Norton Folgate, have signified their willingness to lay on a continuous supply to all houses, if requested to do so by the Commissioners of Sewers. The other companies are now being petitioned to follow suit, but with little prospect of success as long as private corporations control the supply, says the *Sanitary World*.

A VERY short time ago, an engine-driver on the Midlands Railway, of England, was caught by the projecting net of a "mail-bag catcher" on a passing "post-office van" and killed. The accident was due purely to the very clumsy device used by our English brethern for receiving and discharging mail-bags from running trains.

Instead of a pivoted bar and hook on the passing car and the simple wooden "holder" by the side of the track, as used on American railways, the Eaglish practice is to hinge to the side of the car a stout rope net strengthened by leathern bands and attached to an iron frame that can be doubled up against the car when not in use. The net is lowered by a handle connected with a balance weight, etc., in the car. The mail-bag is hung up at the station from a projecting arm on a post, and is struck into the net by a Y-shaped thong on the car. Instead of simply throwing the mail-bags from the car, a fixed net at the station and a complicated arrangement of "revolving lever arms," counter-weights, etc., is employed to get rid of them.

It is not astonishing to read, in this connection, that the net-frame is frequently doubled up or swept away by collision with bridges or other structures, and that the mail-bags are sometimes ripped open and their contents badly demoralized. When will our friends across the sea abandon their practice of "using sledges to crack egg-shells?"

Flood Rock.

A personal visit to Flood Rock at an exceptionally low tide, shows that very considerable "surface blasting" will be required to reduce the shattered rock to manageable proportions. This is especially true on the end towards Blackwells Island, where we measured unbroken rock equal in volume to at least 50 tons, or over three times the lifting capacity of the most powerful dredges to be used under the most favorable circumstances.

The natural stratification of the rock lies almost exactly parallel to the north and south galleries as driven; and as far as the surface indications point, the force of the explosives used was there expended in splitting the rock into deep and rather thick slices that are so wedged in that considerable extra work will be necessary to dislodge and further break them up across the cleavage. The Nigger Head is undoubtedly shattered, but is also in large fragments and it is admitted that more powder must be used upon it before dredging is possible.

At the Ward's Island end of the reef, there was comparatively little solid rock in the roof and the overlying boulders are dislodged and deposited in ridges as reported by the divers; at certain points in that end of the reef craters appear where the surface material has gone down into some lower cavity.

What lies below the exterior crust of broken rock can as yet only be surmised; it is however natural to suppose that the lower rock is the more shattered as being nearest to the full force of the explosion.

Speculating upon the results from a miner's stand-point, there is strong grounds for doubting the wisdom of locating the main galleries parallel to the stratification of the rock and the cross galleries at right angles to it. In tunnel driving the most efficient work and rapid progress is expected from a diagonal attack, and this end could readily have been attained at Flood Rock by a different arrangement of the gallery-plan. The same volume of explosive in the final blast would have exerted a greater rending force upon the rock, when disposed in diagonal drill-holes than when stowed away in holes running with the lay of the rock or at right angles to this stratification; it is evident that in the one case the resulting effect would be what miners call a "gun," and in the other case the rock must be broken twice across its grain.

We make this comment simply from what we saw on the occasion of our visit and from our impressions at the time; what controlling conditions may have existed to bring about the plan followed are outside of our knowledge. We trust that a subject so important to engineers will be fully discussed by those who have the exact data upon which to base sound conclusions. In this respect, existing government reports upon this improvement are provokingly terse and vague.

The Proposed Trial of Automatic Freight-car Brakes at Burlington, Iowa

The Master Car Builders have appointed a committee on automatic freight-car brakes, which invites the manufacturers of such brakes to a competitive test to be held at Burlington, Iowa, December 14th, 1885, and May 14th, 1886.

The Chairman of this committee is the Master Car Builder of the Chicago Burlington & Quincy R. R., a road that has 120 freight cars equipped with the Westinghouse brake, and some of the provisions are decidedly interesting; as each brake company will furnish fitted with its device 50, 28 or 30 foot box cars of 40,000 pounds capacity, delivering the same to the committee free of charge, on the C. B. & Q. R. R., on or before December 7th, and leave them there till after May 14th.

As $10 per month would be a fair charge per car this item amounts to over $5000.

No brakes will be allowed on the engines, and hand brakes only on the tenders. Mechanical appliances for operating the car brakes from the engine or tank will be allowed, that is, air pumps or dynamos can be used, but any system of brakes that relies on the retarding action of the engine is ruled out, and this entirely without regard to the cost of the appliance, and it is well known that some appliances in use cost twice as much as others.

Between the December and May trials the trains and equipments will be kept in use on the lines of the C. B. & Q., with no mileage paid, and lastly, unless three competitors appear, there will be no trial.

It is unfortunate that so important a question as that of automatic freight-car brakes snould be environed with such discouraging conditions. At first sight it looks as if the Chairman of the committee had been careful only of the interests of the road he represents, but though the plan looks like gratuitously adding 150 cars to the equipment of the C. B. & Q., for six months at a time when all cars are likely to be employed and most roads have not a superabundance of cars in good repair, it may be doubted if the C. B. & Q. would greatly profit by the project if it was carried out.

The Manchester Ship Canal.

From a late prospectus issued by the Manchester Ship Canal Co., we make the following extracts relating to this important undertaking now chartered by the English Parliament.

The total stock will be £8,000,000, divided into shares of £10 each. The canal itself will conveniently serve a district covering an area

of 7,500 square miles with a population of 7,000,000. Ships of the heaviest tonnage will be enabled to trade direct with Manchester, without the delay of transhipment or breaking of bulk. Vessels can safely navigate the canal at a speed of five miles per hour, and the journey from the entrance at Eastham to Manchester is estimated at eight hours, less time than it now takes to send goods from ship to rail in Liverpool and thence to Manchester. The maximum dues to be levied on ships are the same as now charged at Liverpool, and the maximum canal tolls and dock-rates are fixed by the act at one-half the existing rates by railway or canal to Manchester and one-half the dock and town dues now charged on goods at Liverpool. As an example, a saving of 7s, 6d. per ton on raw cotton bound to Manchester would be effected over present rates.

The probable cost of working the canal is set down at £2,000 per mile, or £70,000 for the entire conal; the working of the docks would bring the total cost of maintenance, etc. to £104,000 per year. The prospectus figures that a traffic of only 3,000,000 tons annually would furnish a net income of £709,000, and a much larger tonnage is expected. They figure also that in seven years from the opening of the canal the traffic will amount to 9,649,316 tons, giving a net income of £1,571,905.

The physical features of the scheme include an entrance at Eastham, near Liverpool, on the Cheshire shore of the Mersey, and a terminus in Manchester. The distance is 35 miles and the minimum depth of water will be 26 feet, and the width ample to allow two vessels to pass at any point. Comparing it with the Suez and Amsterdam canals it would stand:

Suez.....	26	feet	deep	72	feet	bot. width
Amsterdam..	23	"	"	89	"	" "
Manchester..	26	"	"	120	"	"

The level of the docks at Manchester, which are 60½ feet above ordinary tide level, will be reached by four sets of locks. These locks will admit the largest merchant steamer afloat.

Each set of locks comprises (*a*) a large dock, 550 feet by 60 feet; [*b*] a smaller lock, 300 feet by 40 feet for ordinary vessels, and [*c*] one lock, 100 feet by 20 feet for small coasters and barges; these locks can all be worked together by hydraulic power, and vessels can be passed in 15 minutes.

Careful gauging of the rivers Irwell and Mersey, which will be diverted into the upper reaches of the canal, show that there will be more than sufficient water for all purposes. The estimates include large docks at Manchester, Salford, and Warrington, with a water area of 85½ acres and containing four miles of quays. There will also be a mile of quay space on the ship canal in addition to wharves at many places along the line.

British Pounds.

There is some curious interest, of no real importance to us, about the antiquated association of British pounds.

The Arabians in the Middle Ages formed the connecting link between ancient and modern civilization, and after the Western World had been overwhelmed by barbarism it received arts and sciences at their hands. It was from the Arabians that European nations received decimal arithmetic with what we still call Arabic figures; also algebra, as the Arabic derivation of the name reminds us, and the Greek geometry of Euclid was introduced to the West of Europe by means of an Arabic translation. The pile of weights which constituted the old standard of France was said to have been sent to the Emperor Charlemagne by Haroun al-Raschid, the illustrious Caliph of Bagdad. Charlemagne's pound weight has been called *Tirre esterlin*, and was divided into 12 ounces, 8 of these ounces made a marc, and 2 marcs, or 16 ounces, made the old commercial unit of France established some centuries later than Charlemagne's reign. The emperor established a monetary system starting from his pound weight of silver and dividing it into 20 *solidi*, and each *solidus* into 12 *denaria*, one of which was of the weight of 32 wheat-corns. The name *sterling* applied to this unit is explained to mean that it was adopted by the Austrasian Franks, sometimes called *Esterlings*, while people further west continued to use a unit of 24 wheat-corns. Charlemagne's monetary system (though with a slightly different pound unit) was at length adopted in England and Scotland. Perhaps that is the reason why John Bull does not like the franc system to-day. Though his coinage has been frequently debased, he still adheres to £-*s*-*d* for libra, solidus and denarius, and he still calls his money sterling.

English monetary and commercial units were formerly closely related, as may be seen from the oft-quoted statute of 1266, which declares that "an English penny, called a sterling, round and without any clipping, shall weigh thirty-two wheat-corns in the midst of the ear; and twenty pence do make an ounce and twelve ounces a pound; and eight pounds do make a gallon of wine, and eight gallons of wine do make a bushel, which is the eighth part of a quarter;" also from the ancient treatise of weights and measures of 1304 explaining that "every pound of money and of medicines consists only of twenty shillings weight: but the pound of all other things consists of twenty-five shillings." British weights and measures have been changed many times since then. Our present commercial unit is accounted for as follows by the late H. W. Chrisholm, who was the Warden of the Standards: "The pound avoirdupois was evidently taken from the old French commercial pound of sixteen ounces, which was used in many parts of France." Perhaps that is the reason why some Englishmen to-day, prefer it to an international unit of weight.

Cable Transportation at the Mt. Jalla Mines, Near Grenoble, France.

Le Genie Civil, of October 10th, contains an article describing an arial cable road of unusual unsupported length near Grenoble, France. It is used in transporting the products of the cement quarries on Mt. Jalla to such a point at the foot of the mountain that ordinary tramways can convey them to the kilns.

The material to be extracted is a cement rock, called *calcaire de la Porte de Paris*; it is taken from a thick bed of argilaceous and bituminous limestone; is of a black color, of very fine grain and conchoidal fracture. The quarry lies near the top of a mountain rising about 1,430 feet above the city of Grenoble the principle vein making an angle of 15° with a vertical and is nearly 15 feet thick. Twenty stages of drifts have been driven, each about 11½ feet high and separated from each other by a floor of the same thickness. The main gallery is about 1,333 feet above the kilns, and the rock extracted from above this level are passed down to it through vertical shafts, and that from below lifted by elevators operated by water or by steam according to the season of the year.

On leaving the main gallery the product passes about 2,700 feet to the edge of an almost sheer precipice 984 feet deep, at the foot of which are the kilns. It is at this point that the cable road is built, the vertical distance between the point of departure of the cables and the anchorage below being 1,017 feet, and the horizontal distance, 1,558 feet. Between these two points the ground is such that it is simply impossible to establish any communication by highway or railroad, and an aerial cable road naturally suggested itself. But in this case the length of unsupported cable and the load carried exceed by far the previous employment of this system of transport.

There are two fixed cables, each 1,968 feet long, and made of steel wire rope 0.045m. (1¾ inches) in diameter and placed 10 feet apart: the total weight of these cables is about 13,200 pounds. These fixed cables are anchored in the rock above, and at their lower ends are attached to powerful geared wheels by which the necessary tension may be secured.

Originally, the two suspended boxes, or cars, were connected by a cable of 18mm. ($\frac{7}{10}$ inches) diameter, which passed over a brake-pully at the starting point above, and was of such length that when one of the boxes was at the top the other was at the bottom point; a full box thus descending on one of the main cables pulled up the other end of the cable and with it the empty car running on the second cable. The disadvantages of this method were soon appparent; for the connecting cable, which weighed 1,320 pounds, acted as a drag during one-half the length of the run and as a motor during the other half. And under the load due this extra cable the main lines took a very accentuated and variable curve, causing great irregularity in the movements of the loads and sudden changes of tension in the connecting cable. Numerous accidents and the rapid wearing of the cables and brake-wheel resulted from these conditions.

To remedy these serious evils, the connecting cable was balanced by uniting the cars by another cable of like length and dimensions. This now endless cable passed over large inclined pullies above and below; the upper pulley was fixed in a stout framework, and the lower one was attached to a heavily weighted car running on four wheels on an inclined track about 66 feet long, the balance car ascending or descending this track as the tension increased or diminished. With this arrangement a load could be raised up the incline, when occassion demanded it, equalling four-tenths the weight of the descending load.

The cable-car is loaded above by running under a shute into which the cars from the mine dump their loads; when the car arrives at the bottom of the incline it discharged its contents into bins, arranged with loading shutes, by letting fall the bottom of the car, which is hinged for this purpose.

Each car, or box, had a capacity of 0.9 cubic metres (31.77 cubic feet,) and the descending load in one car was 2,200 pounds. The running pullies on the cars, car attachments and all metallic parts, excepting the cables, weighed 18,700 pounds. The velocity of movement in the cars was about 20 feet per second and the car made the ascent in 1½ minutes. The complete trip, including the loading and discharge, was made in three minutes. This plant was capable of handling from 264,000 to 330,000 pounds of rock in a day of twelve hours. The total cost of the plant, not including masonry and timber framing, was 15,500 francs, or, say, $3,100, or about 9 cents per pound of the metallic portion. This system was built in 1874, by Brenier & Co., of Grenoble, and has been working with great regularity and satisfaction ever since, and other cable roads of similar design have lately been built in the same region.

Wells in Sandy Soil.

Chief Engineer Thevenst, of France, has according to the *Annales des ponts et chaussees*, made some interesting investigations relating to the amount of water delivered by wells in sandy water-bearing soil. It was proven that the amount delivered is proportional to the head, or height of pressure and the diameter of the pipe. The latter fact tends to show that the length of the lower edge of the tube influences the flow of water rather than the entire end area of the well. M. Thevenst closed up the end of the pipe by a plate, leaving only a narrow annular space for the entrance of water. This did not decrease the discharge but rather increased it a little. Surprising as

this result is, at first, it is explained by the fact that when the entire end of the tube is open, sand is easily forced up inside the tube; but with the plate added by M. Thevenst this evil is prevented to a large extent.

German Rules for the Consumption of Water.

The German Association of Gas and Water Works, at their last annual meeting, adopted resolutions for the determination of a more accurate base of calculating the consumption of water in cities and towns. They first assumed that it was incorrect to base such calculation simply upon a certain quantity per head of population, as the climate, usual style of buildings, occupation and pecuniary condition of the consumer, etc., had a decided influence upon the amount used. The Association adopted the following allowances as more equitable.

A:— PRIVATE HOUSES.

	U. S. GAL.
1.—Consumption in dwellings per single occupant per single day.	
a.—For drinking, cooking and cleaning	6.9
b.—For washing	3 to 4.6
2.—*Water-closet*	1.5 to 1.7
3.—*Pissoir*, for each 10 feet of sprinkling pipe	183
4.—*Baths.*	
a.—tubs	105.8
b.—Shower-bath	6 to 9
5.—*Garden*; for each hot day and for each 10 square feet of area wetted once	0.5
6.—*Yards*; same as above	0.5
7.—*Paths*; do.	0.5
8.—*One Horse or Cow*	18.0
9.—*One Smaller Domestic Animal*	3.0
10.—*Cleaning one Carriage*	60.5

B:— PUBLIC BUILDINGS.

1.—*Schools*: one pupil one day	0.6
2.—*Military Barracks*; *a*, for one man	6.0
b, for one horse	12.0
3.—*Hospitals*, for one person	30 to 45
4.—*Hotels*, " " "	30
5.—*Baths*, for each tub and shower bath	151
6.—*Wash-houses*, for each 200 pounds of clothing	92
7.—*Butchers*, for each animal killed	92 to 120
8.—*Markets*, for each 10 square feet and each market day	1.5
9.—*Railroad Stations*, water for one locomotive	7200 to 9600

C:—STREETS.

1.—*Sprinkling* of *Streets*, for each 10 square feet of area watered.	
a.—Paved streets	0.30
b.—Macadamized streets	0.46
2.—*Public Parks*, for each 10 square feet once watered and one hot day	0.46
3.—*Public Fountains*, flowing constantly, daily	920
4.—*Public Pissoirs*, for 10 feet of sprinkling pipe and one hour	183

Journal fur Gasbeleichtung und Wasserversorgung 1884, pp. 543-548.

PERSONAL.

At the Congregational Church, Great Barrington, Mass., Wednesday, October, 21, by the Rev. Evarts Scudder, MINNIE ROSE MAC LEAN and NELSON P. LEWIS.

Mrs Lewis is a daughter of the late Edwin W. Mac Lean of Great Barrington, and Mr. Lewis is an engineer engaged on the extension of the Brooklyn Water Works.

PERCIVAL ROBERTS, JR., of the Pencoyd Iron Works, Philadelphia, Pa., will be married on November 11, to Miss Bessye Wolcott Frothingham.

CIVIL ENGINEER CHARLES H. MCKEE has resigned his position in the Delaware and Hudson railroad engineer corps and accepted one with O'Brien & Rogers, to take personal charge of the tunnel near King's bridge on the New Croton aqueduct.

LORENZO M. DAVIS, a civil engineer of this city, was last heard of a year ago, at the head of the Columbia river, where he had just completed a section ot the Canadian Pacific road. As Indian outbreaks have been numerous on the Canadian border, his friends fear the worst. He is the son of L. Davis of this city, and has a wife in Salt Lake City.—*New Bedford. October*, 26.

GEN. GEORGE BRINTON MCCLELLAN, died at his home, at Orange, N. J., on Oct. 29, of neuralgia of the heart. Gen. McClellan was born in Philadelphia, Pa., on December 3, 1826; he was the son of Dr. George McClellan, famous in medical circles and one of the founders of the Jefferson Medical College. After training under private tutors, George B. McClellan entered the University of Pennsylvania in 1840, and remained there two years until, in June, 1842, he entered the Military Academy at West Point. He graduated second in a large class in 1846, and was almost immediately sent to Mexico and participated in the seige of Vera Cruz; then he passed through the battles ending in the capture of the City of Mexico and returned to duty at West Point in June, 1848, with the brevet of captain obtained for gallant conduct on the field.

He remained at the Academy until 1851, doing much good work as an instructor; in the year last named he was ordered to assist in the construction of Fort Delaware, and later was engaged in the government surveys for the Pacific railways until 1854. Being appointed a Captain in the First Cavalry, he was soon after detailed to report upon the Conduct of the Crimean War, then raging, and, in conjunction with Majors Delafield and Mordecai, he published his report under the title of "The Armies of Europe;" it was a clear and manly statement of what they saw, and the work was everywhere received with commendations. In Jan., 1857, Captain McClellan resigned from the army and at once became Chief Engineer of the Illinois Central R. R., with his office in Chicago, and in a short time was made vice president of the same corporation. In 1860 he resigned his position on the Illinois Central to assume the Presidency of the Ohio & Mississippi R. R., and held this latter position when the War of the Rebellion broke out.

The war record of Gen. McClellan is a portion of our national history, and we will not repeat it here with his triumphs, great popularity and his after disappointments, due mainly to political intrigues. It is sufficient to say that he was an unsuccessful candidate for Chief Magistrate of the United States, receiving 1,800,000 votes for that office. After four years spent in Europe, Gen. McClellan was made Superintendent of the Stevens Floating Battery, at Hoboken, and undertook to carry out the ideas of the man who expended $2,500,000 on this huge engine of destruction. After 1871 he was appointed Chief Engineer of the Department of Docks and Piers in New York, and held this position until 1873. In 1880 Gen. McClellan was elected Governor of New Jersey by a handsome majority, and his administration was marked by ability and common sense. In person, Gen. McClellan was 5 feet 8 inches in height, broad shouldered, with a large neck, and handsome, well-set head; he was muscular, and in his earlier days noted for great strength; his eyes were gray and clear, and in manner he was courteous and affable.

THE United States produces about 21 per cent. of all the pig iron, 27 per cent. of all the steel and 25 per cent. of all the coal produced in the world. In the production of these commodities Great Britain is the only country that leads her. In the case of steel the lead is very slight, and in a few years the two countries will have exchanged places. The most of this great progress in the United States has been made within the last twenty-five years, during which period Protection has been the steady policy of the Government.

Liverpool Engineering Society.

The ninth meeting of the current session was held at the Royal Institution, Colquitt street, on Wednesday evening, October 14th; Mr. W. E. Mills, president, in the chair. A paper by Mr. Peter Evans, on the "Application of Compressed Air to Warehouse Requirements," was read by the author. After giving a general description of the hoisting machinery at the Boundary street warehouses of the Warehouse Owners' Company, Limited, including a description of the engine and boiler house, with air compressors, air mains, receivers and connections to power hoists, the author described the system of cooling and improving cereals, and also of elevating and distributing same by means of compressed air. He then compared the first cost and working expenses of the different systems of transmitting the power for working the hoists, and showed the economy of compressed air in the case under consideration. The application of compressed air for refrigerating purposes was next dealt with, and he showed how warehouse cellars might be made valuable as stores for dead meat by exhausting into them the air after it had done its work in the hoists, the air on expansion producing an intensely cold, but pure, atmosphere. In conclusion he pointed out the great demand for a reliable compressed air-power meter, by which consumers could be charged for the amount of power actually used.

CORRESPONDENCE.

NEW YORK, Oct. 28, 1885.

EDITOR ENGINEERING NEWS:—In your issue of October 24th, you say of the proposed dredging at Flood Rock:—"If the dredging of broken rock is to cost $6.38 per cubic yard, in the present work, we must say that we can hardly see where the economy of the system adopted at Flood Rock comes in. We understood that it was cheaper to dredge than to excavate in the galleries; but the average price of tunnel excavation, in a very similar rock in the new Croton Aqueduct, is only $5.54 per cubic yard, on the Brown, Howard contract, and the section is practically the same. If the dredging alone is to add about $1,250,000 to the cost of the improvement it might have been cheaper after all to have robbed the pillars somewhat more and likewise to have thinned the roof."

The reports of the Chief of U. S. Engineers seem to show, as quoted below, that the cost of excavation at Flood Rock was decidedly greater than you have assumed.

	1882 p.646	1883 p. 533	1884 p. 630
Lineal feet of Headings.	19,976.58	29,108.9	23,180.9
Cubic yds. of Rock in place excavated.	61,298.21	70,349.9	70,349.9

The appropriations have been for years ending June 30th, as follows:

1876	$ 22,393.19	(Expenditure to date.)
1877	31,799.78	
1878	9,734.70	
1879	87,635.91	
1880	135,135.05	
1881	163,649.49	
1882	205,041.63	655,389.75
1883	161,894.02	817,283.77
1884	19,633.86	836,917.63

Neglecting the quantities for 1884 as evidently containing a misprint, we have:

Cost per cubic yard,	1882	$10.69
" " "	1883	11.62
Cost per lineal foot,	1882	32.80
" " "	1883	40.64
Cubic yards per foot run,	1882	3.07
" " "	1883	3.5
Area in square feet	1882	82.9
" " "	1883	94.5

That a considerable factor in this expense was due to pumping water cannot be doubted, and that any further work, being enlargement, would cost less is also apparent. But as dredging in this locality may be assumed to be at least one-fourth cheaper than in 1877, there was a reasonable anticipation that the blasted rock could be lifted for $3.50 per yard, and it is submitted that the engineers in charge displayed good judgment in profering dredging to the risk of congressional appropriations.

Breakages of Axles on German Railroads.

Every year statistics are published by the *Verein Deutscher Eisenbahn-Verwaltungen* as to the breakages of axles which have taken place on the various railways whose managements are connected with the above society. Some of the figures for 1884 are as follows: The returns from 45 railways give the number of broken axles as:

On locomotives	35 axles (in 1883 the number was	19
On tenders	28 axles (in 1883 the number was	35
On Passenger carriages	3 axles (in 1883 the number was	3
On goods trucks	96 axles (in 1883 the number was	10
Total	162 axles (in 1883 the total was	152

As concerns the season during which these breakages took place or were discovered, it is stated that 85 took place in summer, (April to September), and 77 in the winter, so that in 1884, as in former years, no influence of severe weather can be traced. The time during which the axles had been in use averaged 14 years 11½ months on the locomotives, as against 14 years 8 months in the previous year; 19 years 2 months on the tenders, as against 14 years 8 months in the previous year; and on the carriages 17 years 1¾ months, as against 15 years in the previous year. The average life of the axles thus shows a decided increase as against former years. The figures given, showing the average mileage of the axles broken in 1884, indicate a considerable increase as against the former year. The maximum distances recorded are in the cases of a driving-axle of a locomotive, made of wrought-iron, which has run 902,757 km.; an axle on a tender, which ran 655,168 km. (material not stated), and an axle on a truck, which ran 563,494 km. Of the 162 broken axles, 103 were of iron and 59 were of steel.

Arranging the broken axles according to their ages, it results that no iron axle broke during the first 10 years, but 16 steel axles did break; 44 iron and 25 steel axles broke from the tenth to the twentieth year; 28 iron and six steel axles broke from the twentieth to the twenty-fifth year; over 25 years there were only iron axles broken. The oldest iron axle was 32 years old; the oldest steel axle was 25 years 9½ months. The causes of breakage are given as in 34 cases owing to faults in the material, or 21 per cent.; of these there were 28 cases of iron axles, in 39 cases, or 24 per cent., the breakages were owing to old flaws, of which many might have been detected by proper examination. The number of axles found to have flaws in them, and which were changed, owing to inspection in the sheds or elsewhere, is returned by 33 railways as 1756, compared to 1480 in the preceding year. Of these 1638 were of iron, and 118 were of steel.

Forth Bridge Railway.

The following is the tenth quarterly report of inspection by Major-General Hutchinson, R. E., and Major Marindin, R. E., of the works in progress for the construction of the bridge over the River Forth.

Railway Department, Board of Trade
I, Whitehall, London, S. W.
September 8, 1885.

Sir,—We have the honor to report, for the information of the Board of Trade, that in compliance with the instructions contained in the order of October 26, 1882 (R. 10,354), and in accordance with the provisions of the Forth Bridge Railway Act of 1882, we have made our tenth quarterly inspection of the works in progress for the construction of the bridge over the River Forth at Queensferry.

These works have progressed satisfactorily since our last inspection at the end of May, and the following is a short description of the works executed during the last quarter, and their state at the present time.

TEMPORARY WORKS.

At South Queensferry.—An extension of No. 2 shop is in progress. The new machinery includes two lathes; two surfacing machines; one emery grinder for bedplates; twelve hydraulic presses; four winches, winding engine, and gear; hydraulic engine and gear for lifting the viaduct girders; two multiple drills and several rivetting machines, among which are two large ones for rivetting the 12-feet tubes.

At Inch Garvie.—The iron staying between the piers has been finished; it covers more area than was originally intended. Additional hydraulic power has been supplied for rivetting the permanent work.

At North Queensferry.—Timber staging has been placed between the main piers for the erection of the horizontal tubes and the north cross girder. The appliances for lifting the viaduct girders are now in use.

PERMANENT WORK.

At South Queensferry.—The two south main piers are finished, and the north-east pier is all but completed. The temporary work in connection with the tilted caisson for the north-west pier is all completed, and by dredging away the mud at the south side of the caisson, it is being drawn over towards the vertical: it has already moved 3 inches in this direction, and it is hoped that the caisson will be shortly pumped out and floated. Six spans of the viaduct girders have been erected and are ready for lifting; the seventh is nearly ready.

At Inch Garvie.—The bedplates of the north-east and north-west main piers have been rivetted up and fixed in their final positions.

The south-east caisson has been sunk to its final level, the cutting edge being 54 feet 9 inches below mean tide level; the air chamber has been filled with concrete and the air-locks removed; the filling in with concrete above the air chamber is proceeding, and has now reached the level of 14 feet below mean tide level.

The south-west (and last) of the caissons was launched on May 29th, and floated into position on July 16th; since this, sinking has been continued, and the caisson has already been lowered 8 feet into the rock; the filling in with concrete above the roof of the air chamber is in progress, and has now reached a height of 33 feet above the cutting edge.

At North Queensferry.—All four main piers are completed, the lower bedplates fixed on three of them, and that for the fourth (the south-east pier) is now being erected. The horizontal tubes between the north and south main piers, which tubes form part of the cantilever, have nearly all been placed in position, and will be rivetted as soon as the rivetting machines are erected; preparations are also being made for commencing the erection of the upper bedplate and skew-back for the north-west pier.

The cantilever and viaduct piers remain at the same level as in May last, but as the lifting of the girders was commenced on August 25th, and the whole five spans have now been raised 3 feet the building of the piers will be again at once proceeded with.

GENERAL REMARKS.

About 275,250 cubic feet of granite have been delivered up to date, of which 232,400 cubic feet have been set; about 82,360 cubic yards of concrete and rubble masonry are in position, and 13,750 tons of cement have been used. All the bedplates, upper and lower, for the twelve main piers are either erected or ready for erection.

The eight skewbacks for the North and South Queensferry piers are in course of construction, the two for North Queensferry north east and north west piers being nearly completed, while the other six are in various stages of progress.

The horizontal tubes between the main piers at North and South Queensferry are ready for erection, and, as above stated, two are in position. About 160 lineal feet of those for Inch Garvie have been drilled.

About 575 lineal feet of vertical columns, 1,330 lineal feet of diagonal struts, and 700 lineal feet of curved lower members have been drilled.

About 2,000 lineal feet of the lattice girder tension members of the cantilevers including the top members between the vertical columns at North and South Queensferry, are ready for erection. Good progress has also been made with the junctions of these top members with those of the cantilevers outside the piers.

12,790 tons of steel have been delivered, exclusive of 2,390 tons for the viaduct spans.

The average number of men employed during the last three months has been about 2,200.

In conclusion, we are glad to be able to report that good progress appears to have been made in all departments of the work during the past quarter, and that, so far as our inspection enables us to form an opinion, the quality of the work maintains its high character.

We have, &c.,
C. S. HUTCHINSON, Major-General, R.E.
F. A. MARINDIN, Major.

The Assistant Secretary,
Railway Department, Board of Trade.

SOME call it luck; others say it was business ability. It was neither. It was shrewd and judicious advertising.

THE man who advertises in dull times will never feel dull times.

The Tay Viaduct.

At the recent meeting of the British Association Mr. Crawford Barlow read a paper on the Tay Viaduct, which is being constructed at the side of, and 63 feet distant from, the Tay Bridge, which was destroyed in December, 1879. Its total length is 3,600 yards; the number of spans is 85, varying from 50 feet to 230 feet in length; the greatest height of rails above high water is 83 feet, and at the navigable channel in the middle of the river there is a clear headway of 77 feet for shipping.

The southern or Fife end of the Viaduct consists of four arches of 50 feet spans with their abutments and piers, all built of brick. In plan this arching is wider at the southern than at the northern end, to accommodate a junction of the Newport branch with the main line.

The northern or Dundee end consists of seven spans over the Dundee esplanade and its proposed extension, the first two spans of which are wrought-iron skew-arches, to suit the direction of the intended esplanade, and the remaining are girders on brick piers and cast-iron columns.

The central portion of the viaduct, over the tidal water, has 74 spans, consisting of wrought-iron girders resting on piers. The cylinder foundations of the piers are constructed of wrought-iron caissons, with the exception of a few which are of cast-iron, up to low water level, lined with brickwork and filled with concrete, above which is a brick shaft also filled with concrete; the diameter of their bases varies from ten feet to twenty-three feet, according to the spans. Except in a few cases where rock is met with, the cylinders are sunk to a depth between twenty feet and thirty feet below the bed of the river, so as to be out of reach of the scouring action of the tide; and before building the upper part they are tested with a weight of thirty-three per cent. more than the maximum load which can come upon them. At the top of the cylinders and above high water is a strong connecting piece, eight feet high, and nearly as wide as the diameter of the cylinders, constructed of cast-iron girders, wrought-iron ties, brickwork and concrete. Above this is the wrought-iron superstructure or shaft of the piers, consisting of two octagonal shafts rising from each cylinder, and attached to the same by long bolts; these shafts are joined together near the top of the pier by a semicircular arch forming at the top one structure. The whole is constructed of wrought-iron plates riveted together, with channel, tee and angle irons.

The dimensions of the girders are very various and are as follows:

11 spans with	245 feet	girders	
3	"	227	" "
1	"	162	" "
13	"	145	" "
21	"	129	" "
1	"	113	" "
24	"	71	" "
1	"	56	" "

The thirteen large spans are near the middle of the river; each of these consists of a pair of hog-backed girders, the rails being laid between and at the bottom of them. The rest of the spans, twenty-four on the south side and thirty-seven on the north side, are constructed with four rectangular girders (the outer ones being the girders of the old bridge) on the top of which the rails are laid.

The flooring is corrugated in form throughout, and on each side of the viaduct is a wrought-iron lattice-work parapet, five feet high above rail level.

The Act of Parliament authorizing this undertaking was obtained in 1881, and the works were commenced in 1882.

The present state of the work is as follows: The southern and northern ends are completed to the level of the railway, and at the central portion, or viaduct proper, fifty-eight piers have their cylinders sunk, twenty-nine piers have their wrought-iron shafts erected,

and ten spans have the girders in position and are completed to the railway level. The girders and flooring for each of the thirteen large spans are being built entire on a staging at the south end of the viaduct, and arrangements are being made by which they will be floated out and placed in position on the cylinders, and then raised hydraulically to their proper position, the wrought-iron shafts of the piers being built up at the same time.

All the wrought-iron and steel required for the work is carefully tested, the tests being that the wrought-iron must be capable of bearing a tensile strain of twenty-two tons per square inch, with an extension of 6.25 per cent. in a length of eight inches, and the steel twenty-seven tons per square inch, with an extension of 15 per cent.

In carrying this work into execution a great amount of plant has been required, and a number of ingenious machines and clever contrivances for the better execution of the work and the saving of labor have been devised and brought into operation by the contractors, Messrs. Wm. Arrol & Co.

Surveying Instruments.

A curious surveying instrument is described in the *Builder*, which is capable, not only of measuring the heights as well as the horizontal distances of various objects from a single station, but plots automatically on a board fixed to the stand of the instrument the exact position of the points under observation, at any desired scale. This wonderful instrument, which is the invention of Professor Cerebotani, of the University of Verona, consists essentially of two telescopes, one fixed and the other movable, carried at the opposite ends of a strong steel bar. In taking observations the instrument is placed with this bar in a perfectly horizontal position, and both telescopes are then directed upon a given object. Of course, only things in the some horizontal plane with the telescope can be seen through both of them at once, and if the object whose position is to be ascertained is above or below this plane, a point at the proper distance above or below it is first observed. It is evident that when both telescopes are trained upon the given point, two lines passing through their axes will intersect in that point, and will form, with the line of the steel supporting bar, a triangle, the base of which is the length of the bar. It would be easy, with a horizontal circle, to read off the angle of convergence of the two telescopes, and calculate from this the distance of the object; but Professor Cerebotani accomplishes the same result still more easily by attaching a drawing-board to the stand of the instrument, over which a straight-edge is carried by the motion of the movable telescope, in such a way that while the straight-edge is always parallel with the axis of the movable telescope, one end of it remains always at the same distance from another straight-edge parallel to the axis of the fixed telescope. This distance is made an aliquot part of the length of the steel supporting bar, and when the two telescopes are made to converge upon a given object, the straight-edge at the same time intersects the fixed index, forming a triangle on the board exactly similar to that formed by the imaginary prolongations of the axes of the telescopes, but having for its base a definite fraction of the length of the steel bar, instead of the steel bar itself.

Supposing the ratio of the base of the triangle formed by the straight-edges to be to the length of the steel bar as one to twenty, the distance of the object viewed will be twenty times the length of the portion of the fixed line cut off by the movable straight-edge when both telescopes are trained upon it. For rough work this distance might be read directly from the index, but in practice a micrometer screw is used to determine the exact length, and the reading of the micrometer is interpreted by a table which is sent out with the instrument. The horizontal distance of the object being thus ascertained, its height is easily determined by the movable telescope turned in a vertical circle, the altitude being simply the product of the horizontal distance by the natural tangent of the vertical angle observed. The two straight-edges, as their position shifts over the board while the instrument is turned to different points, afford the easiest possible means for plotting the positions of all the points upon a sheet of paper fixed to the board, and a map of a given district may virtually be drawn by the simple process of looking at different portions of it from a single point. As the length of the steel bar which forms the base-line of the main triangles is liable to vary by expansion and contraction, perfect accuracy in surveying with the new instrument can only be obtained by laborious correction of the observations; but for rough work, where an error of one foot in two hundred, which is believed to be the maximum with careful handling, is unimportant, the Teletopometer, as its inventor calls it, is likely to be useful; and it is said that military engineers are already experimenting very successfully with it.

Trials of Water-Meters.

The Industrial Society of Mulhausen, (Alsace) publish the following results of trials of water-meters:

System of Water Meter.	Number of Trials.	No. of reliable records.	No. of unreliable records.	Proportion between inexact records and the total number of trials.	Largest error.	
				Per cent.	Per ct.	Per ct.
Faller.	31	24	7	22.85	11	40
Kennedy.	23	11	12	52.72	2.04	9.4
"Crown."	31	11	10	64.51	4	32
Saman.	31	5	26	83.87	——	50
Siemens, Halshe.	32	5	27	84.37	——	100
Valentin.	32	4	28	87.50	10	100
Frazer.	31	2	29	93.54	——	8
Dreyer, Rosenkranz and Droop.	32	1	31	97.05	2 5	40
Tylor.	31	0	31	100.00	28.2	100

LITERATURE.

A Text Book on the Materials of Construction for use in Technical and Engineering Schools. Abridged from "Materials of Engineering." By ROBERT H. THURSTON, M. A. Doc. Eng. Professor of Mechanical Engineering, of Sibley College, Cornell University; Past President Am. Soc. Mechanical Engineers; M. Am. Soc. C. E.; Am. Inst. Mining Engineers, etc. etc., New York, John Wiley & Sons, Publishers, large 8vo, pp. 697. Price $5.00

We are glad to see this very useful book put into a shape that will extend its circulations among engineers. The original work, in three volumes, has already been fully noted in this journal; this volume contains the substance of the more extended treatise, and has the advantages, to many, of a reduced cost, and more manageable form. The field covered is as wide as the range of the title, and passes from wrought and cast-iron and steel, through the other metals used in construction, to stones, cements and timbers. It is a work that should be found on the shelves of every engineer, if the larger and more detailed treatise on the same subject is not already there.

Select Plans of Engineering Structures for Railroads and Highways as actually constructed. Dimensions, Quantities and Cost. By RICHARD B. OSBORNE, C. E., M. I. C. E. I. Published by the author. Phila. 1885. Oblong Folio, 35 Plates. Price $6.00.

We have already given an advance notice of this work, but now announce its publication. As this edition is limited to 1,000 copies a number of which have already been subscribed for, intending purchasers should make haste in their orders. The plans illustrated are from actual works done, and among them we notice the detail of the Sixth St. Skew Bridge, in Reading, Pa., undoubtedly the most elaborate bridge of this type ever constructed in the U. S.; it is on a skew of 48¾° with a main square span of 30 feet, and two side-arches of 8 feet span. The remaining plans cover nearly every type of railway masonry construction.

Indo-European Overland Telegraph.

A project is on foot for an overland line of telegraph from India to Europe through central Asia. An important feature of the project is found in the fact that it is intended to combine commercial with such strategic points as may be deemed necessary in its construction. Charles. E. Pitman, chief superintendent of telegraphs in India, in a pamphlet on the subject, says that the proproposal is for an extension of the Indian telegraph lines from Chaman, seventy-seven miles east of Candahar and about sixty-three miles west of Quetta, via Candahar and Herat to Mesched, near the Persian frontier. Persia has already a telegraph line from Teheran to Mesched, which is to be extended to Sarakhs, a place which has already been put into telegraphic communication with Merv and the Caspian by Russia. If the Ameer could be induced to construct a line through Afghanistan and guard it, there would be no physical difficulties of any importance between Quetta and Herat. The total length of the new line required is a little over 600 miles, viz., about 400 miles from Chaman to Herat and 220 from Herat to Mesched. The line between Mesched and Teheran would provide a complete land line between England and India. The connection with the Russian system at Sarakhs via Askabad, Baku and Tiflis would give an alternative route. Turkey has a line which runs from Constantinople via Diabekir and meets the Persian line westward from Teheran. The construction of the system, it is asserted by the Manchester *Guardian*, would operate to lower the Indian cable charges and prove of great advantage in the commercial exploitation of Asia Minor.

TREATMENT OF STEEL.—Further tests of the new French treatment of steel for rendering it tough, appear to confirm its value, imparting to it also a fineness of grain, an increased hardness and a notable accession of strength to withstand rupture; this effect being most marked in the case of highly carbonated steel, and in this respect the metal is made to resemble tempered steel, without being in all points identical with it. The cause of this alteration in physical condition is attributed to the rapid heating and no less rapid cooling of the metal; that is, when the red-hot steel is first strongly compressed, which is the peculiar feature of this process, the conversion of the mechanical energy into heat serves to raise the temperature of the entire mass, at the same time that the particles of the metal are more closely cemented together; this effect is followed by a rapid cooling, due to the contact of the plates of the hydraulic press with the surfaces of the metal, and the very close pressure materially increases this conducting effect of the cold metal.

A SURE SIGN OF RETURNING GOOD TIMES.—All the book publishers report longer lists of works in preparation this fall than usual. The fact is a gratifying evidence of that revival of business which has already made itself manifest in many ways. When the times press hard upon men, almost the first economy practiced is in cutting off of purchases of books, for, as Charles Reade contended, human beings care quite ten times as much for their bodies as their minds, and the man is rare who, when compelled to practice economy, begins by reducing the cost of his dinner in order that his supplies of intellectual food may not be lessened. When men begin to buy books freely again the fact may be taken as a sure indication of their improved condition financially. The improved demand for literature is unquestionably a good thing in itself, and the undertakings of the bookmakers this year may be confidently counted upon to minister well to the need that has been so long neglected.—*New York Commercial Advertiser*

Progress of Krupp's Works.

The progress of the works of Herr Krupp, at Essen, continues to be one of the marvels of modern industry. The most recent and authentic data, as summarized in the *Engineer*, show that in 1860 the total number of workmen employed by Herr Krupp was 1764. In 1870 they had increased to 7084. At the present time—1885 the total number employed in all the establishments of Herr Krupp exceeds 20,000. If we add the wives and children dependent upon the workmen, the total number of persons supported by the Krupp Works is not less than 65,381. Of this number fully 29,000 dwell in cottages built by Herr Krupp and belonging to his works. There are eight separate and distinct departments belonging to this enormous concern. In the first place, we have the vast extent of workshops at Essen; secondly, three coal mines at Essen and Bochum; thirdly, no fewer than 547 iron-ore mines in various parts of Germany; fourthly, several iron mines near Bilbao, in Spain; fifthly, an extensive series of smelting furnaces, and, sixthly, the ranges at Meppen for the testing of the Krupp guns. Besides the eleven smelting furnaces there are 1542 puddling and heating furnaces.

The number of steam boilers employed in Herr Krupp's Works is 439, and the total horse-power of the 450 steam engines in use is 185,000. There are 37 miles of railroad in the works, on which the traffic is performed by 88 locomotive engines, and a park of 893 freight cars. There are no fewer than 35 telegraph stations, with 40 miles of telegraph wire and 55 Morse apparatus in operation in the works.

COATING FOR IRON.—Mr. Puscher, of Nuremberg, has devised a very simple process of giving iron and other metals a black coating resembling enamel, and one that is very even and regular, since it is not applied with a brush. *La Nature* describes it as follows:—Into a box about 20 inches in height is put sufficient powdered soft coal to cover the bottom to a depth of about three-quarters of an inch. About three-quarters of an inch above this is placed a grating, and upon this are laid the objects to be treated. After closing the box hermetically it is placed over a fire. The moisture contained in the coal evaporates, and thick bituminous vapours are given off. The bottom of the box is kept at a dull red heat for about half an hour, and the box is then removed from the fire, and after a time is opened. The coal will be found converted into coke, and the objects lying upon the grating will be covered with a black layer resembling enamel, but more adhesive and especially more elastic than the latter. Articles thus treated may be bent and be exposed to great variations of temperature without the coating undergoing the least change.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(CONTINUED FROM PAGE 269)

DCCLXXXIX. WINSTON, N. C.

Winston, North Carolina, in lat. 26° 7′ N., long. 80° 15′ W, the county seat of Forsyth Co., is on the Piedmont range of mountains, at 1,000 feet above the sea. It is a tobacco manufacturing town of some importance, the internal revenue collected there amounting to $1,125,000 annually.

Water-works were built in 1881 by a private company, after plans of Col. J. W. Andrews, Am. Soc. C. E., and under the direction of George W. Hinshaw, taking the supply from a spring, the water from which is collected in a well 15 feet in diameter, and 30 feet deep, with brick walls 2½ to 2feet in thickness, the upper portion being laid in cement.

This pump well is near a branch of Atwood Creek, across which a stone dam is built, furnishing the power to run the pump and a supplemental supply in case of necessity. Thence the water is pumped by a Worthington pump of 288,000 gallons daily capacity, driven by an over-shot water-wheel, through 3,000 feet of 6-inch wrought-iron pipe to a reservoir 79 feet long, 78 feet wide, and 21½ feet deep, having an elevation of from 16 to 65 feet above the residence, and 40 to 100 feet above the business portions of the village, and 210 feet above the pump. The reservoir walls are of brick laid in Portland cement, and are 11 feet thick at the base, and battered on the outer face from the surface of the ground, to within 5 feet of the top, from which point to the crowning coping, they are perpendicular, and 3 feet thick.

Distribution is by 4 miles of cast-iron pipe of 10 to 4 inches in diameter, with 40 fire-hydrants, 13 gates and 92 taps.

Three meters are in use. The daily consumption is 75,000 gallons. Service pipes are of iron and lead. The village pays $20 annually for the use of each hydrant. The population in 1880 was 2,854. The cost of the works has been $42,500. The bonded debt is $24,000 at 8 per cent. The expenses of maintenance, in 1884, were $400 and the receipts $2,800. Thos. J. Wilson is president, and Geo. W. Hinshaw superintendent, seceretary and treasurer.

DCCXC. WOODSTOCK, N. B.

Woodstock, New Brunswick in lat. 46° N., long. 67° W., is on hilly ground on the River Saint John.

Settled in 1820, it was incorporated a town in 1855. Water-works were built by the town in 1884, after plans of Crafts and Forbes, Civil Engineers, taking the supply from the river. The water after being filtered through five feet of loose stone into a crib well, is pumped by a pump, with bucket of 11 inch and plunger of 8 inch diameter and 14 inch stroke, driven by a compound engine made by the Burrell, Johnson Iron Co., directly into the mains furnishing an ordinary pressure of 70, and a fire pressure of from 100 to 130 pounds.

Distribution is by six miles of cast-iron pipe of 10 to 3 inch diameter with 74 fire-hydrants, 83 gates, one meter and 200 taps. Service pipes are of enameled iron.

The daily consumption is 30,000 gallons. The works have cost $55,000, which is the amount of the bonded debt at 6 per cent. The population in 1880, was 2,000 and is now said to be 3,000. Donald Monroe is Superintendent.

DCCXCI,—SWAMPSCOT, MASS.

Swampscott, Essex Co., Massachusetts in lat. 42° 40′ N., long 70° 55′ W. Settled in 1629 it was incorporated a town in 1852. Water-works were built by the town in 1853-4 taking the supply from the works of the city of Lynn. Mass., (see ENGINEERING NEWS, page 293 vol. viii. July 23, 1881).

There have been 3½ miles of sheet-iron and cement pipe laid with 30-fire-hydrants, for which the town pays $500 annually. As yet no provision has been made for domestic supply but it is expected that upon the completion of the extension of the Lynn works to Saugus River water for that purpose will be obtained. The works to date have cost $14,550. The bonded debt is $15,000 at 4 per cent. The population in 1880 was 2,500. A. R. Bunting anages the works.

DCCXCII. GREENVILLE, ILL.

Greenville, Illinois in lat. 38° 55′ N., long. 89° 30′ W., is the county-seat of Bond Co.

Water-works were built in 1884, by the city after plans of J. G. Briggs, C. E., taking the supply from ground water. From a well of 26 feet diameter, 40 feet deep, the water is pumped by two Blake steam pumps of 750,000 gallons daily capacity each directly into the mains. Distribution is by 2½ miles of Kalameined wrought-iron pipe of 8 to 4 inch diameter, with 22 fire-hydrants and 11 gates. The works having so recently been completed the number of taps cannot be given.

The works have cost $16,000 which is the amount of the bonded debt at 8 per cent. The population in 1880, was 1,886 and is now said to be 2,500. J. B. Pierce manages the works.

WATER

BELFAST, ME., is figuring on water works.

IT is probable that water works will be constructed at Mifford and Bennett, Nebraska.

A WATER WORKS company has been incorporated at Chippewa Falls, Wis.

CHARLOTTE, MICH., contemplates using in her proposed water works 9¼ miles of pipe and 54 hydrants.

THE Alpena, Mich., Gas Company have commenced laying their pipes.

HANNIBAL, MO., is agitating the question of electric lighting.

THE Atlas Company is making five-ton bed plates for the Pittsburg Water Works.

BIRMINGHAM, ALA.—The first steam fire engine ever in the city has been received by the fire department.

SALINA, KAN., has granted the franchise to the Salina Electric light company to furnish the city with Edison incandescent light, the works to be in operation by June 1, 1886.

LINCOLN, NEB., will supply the Union Pacific R. R. with water in that city on a basis of four tenders and trains per day, and 7,000 gallons for the same time for $250 per year.

A STOCK company has been formed at Monongahela, Washington County, Pa., to sink test wells for natural gas or oil. Ten thousand dollars stock was subscribed which amount will be raised to $20,000 if necessary.

THE people of Waterloo, Iowa, have voted to have water-works, which will be owned and operated by the city. For further information address Lewis Lichty, mayor.

THE contract for furnishing plans for a system of water-works at Ashland, Neb., has been awarded to Mr. Richardson, who has just completed works at Lincoln, Nebraska.

Water.—The contract has been signed for extending the water supply service of Richfield Springs, New York, at $11,200 and has been let to T. Sullivan of Syracuse.

Stand-pipe.—Messrs. E. E. Palmer & Son, Kansas City, Mo., have been awarded the contract for building stand-pipe for the Lexington Water Company, of Lexington, Mo. It will be 18 1-25 feet in diameter by 150 feet in height; capacity 300,000 U. S. gallons; contract price $10,000.

AT the reservoir of the Lowell, Mass., water-works, which is being repaired, five derricks fell simultaneously October 20, owing to the snapping of a guy rope. One man was killed, and three injured. The City Engineer, Mr. James P. Roberts was among the latter.

THE Manhattan Construction Company, New York, of which Col. S. H. Lockett, formerly of Knoxville, Tenn., is chief engineer, has now five different water-works in process of construction. They commence work at Salina, Ala., on November 1.

AT Wallingford, Conn., H. J. Kellogg, of Waterbury and James R. Patterson, of New Haven, are surveying the borough for the purpose of sewering it. The great trouble is in the lack of fall on the plains. The main will need to be laid from 10 to 15 feet deep in some places.

THE Oceanside Water Company has been incorporated for the purpose of supplying the town of Oceanside, in San Diego County, Cal., with water for domestic, manufacturing and irrigation purposes. Directors—Maymus Tait, C. F. Francisco, Andrew J. Meyers, M. S. Wetzel, James Crawford. Capital stock, $6,000; divided into 120 shares.

THE fire committee of Palmer, Mass., has voted to make a contract with the Palmer water company to put in 40 hydrants, to be placed at the discretion of the engineers, at an annual rental of $20 each, the $800 to cover all water used for fire purposes. Should it seem desirable to extent the water-mains to other parts of the district the water company shall do it, under the terms of the contract, putting in a hydrant at every 500 feet at the same rate.

EVANSVILLE, IND., Oct. 27.—The Connecticut Mutual Life Insurance Company has sued the city for the payment of $60,000 interest on defaulted water works bonds amounting to $3,000,000. The bonds were reissued in 1870, when the works were completed, and not a cent on them has ever been paid. The terms of the bonds give the purchaser a lien upon the works, and consequently the company is in possession.

THE Moberly, Mo., water-work were tested successfully Oct. 24. With a pressure of 120 pounds, four streams were thrown to a height to 80 feet. The contract calls for six streams, and the engineer stated that eight streams can be forced to the same height. Mr. Masten is chief engineer. The works include an artificial lake of 110,000,000 gallons capacity, and cost $125,000. The supply is for a population of 40,000.

TWELVE bids for the Harford Run sewer were opened at the Mayor's office, Baltimore, Oct. 19.

THE City Council of Lake City, Fla., has authorized the street committee to begin the construction of a sewer to empty into Lake De Soto.

THE reservoir of the Lake Village, N. H., water-works is completed, and the pumps are delivered. It is expected water will soon be supplied. The reservoir is 115 feet by 113 feet, and 10 feet deep.

CHATHAM I. EWING, banker, Cherrydale, Kansas., has been granted a franchise to build water works to supply Ottawa, Kan., with water. Works to be completed September, 1886. The same party is building water works for Cherrydale.

DEMOPOLIS, Ala., Oct. 18th.—Water was reached yesterday in the new artesian well at a depth of 690 feet. The stream is ten gallons per minute strong, and drilling continues that more water may be obtained.

THE Paola, Kan., Water-works company was organi d October 12th. The incorporators are James C. hming, John D. Weeks and Charles A. Jersey, New ork City; E. J. Snow, Brooklyn; J. W. Sponable, E. W. Robinson and Sperry Baker, Paola.—*Paola Republican.*

THE chimney at the water-works pumping station at Fall River, R. I., which was struck by lightning several weeks ago has resisted all efforts to pull it down. Oct. 23, a company of the 1st. Regiment stationed a 12-pound gun 200 feet distant and with one solid shot and 13 unloaded shells knocked down the 40 feet of chimney forming the dangerous portion.

THE water-works at West Linco'n, Nebraska, were satisfactorily tested Oct. 23. The pressure was 160 pounds; and from a point 90 feet above the engine-house a stream was thrown to a height of 85 feet. The well has proved a failure so far, and the water is taken from a barrel supplied by the creek. Mr. Richardson was the contractor.—*Nebraska State Journal.*

A SPECIAL meeting was held October 22nd, by the Hyde Park, Ill., Board of Trustees to discuss the much vexed subject of the purchase of additional pumping machinery of a daily capacity of 12,000,000 gallons for the Hyde Park Water-Works. Bids were received about two months ago from a number of the foremost manufacturers of the country. Visits of inspection were made by a special committee and a report presented. The report was not accepted, and a long-continued wrangle has followed since. At this meeting representatives of the interested firms were given opportunity to present the respective merits of their machines preparatory to final action by the board at the next regular meeting.—Chicago *Tribune.*

AT a meeting of the Hyde Park, Ill., Board of Trustees, October 26th, the long contest over the purchase of new pumping machinery was ended. The contract was awarded to the Holly Manufacturing Co., at $51,000; the highest of the four bids sent in; the others were, Henry R. Worthington, $52,750; E. P. Allis & Co., $46,-000; Gordon & Maxwell, $49,000.

THE wells and cisterns at Little Rock, Ark., are giving out, and the water supply of the city for drinking and cooking purposes is becoming a serious consideration. Wells that have always been considered unfailing have given out in the eastern, western and southern parts of the city. The city council have a difficult problem in securing a good water supply, but it is the most important question now before the city government.

THE greatest drainage enterprise ever undertaken in Illinois is the canal now advancing at the rate of 400 feet a day in Piatt county. The entire length will be fifteen miles, from the village of Ivesdale on the Wabash railroad to Maple Lake The width of the canal will be 35 feet, and its depth 7½ feet. The course of the canal is through a large tract of low, flat prairie subject to overflow in every wet season, and having no natural drainage.

THE superintendent of the Montreal Water-works has prepared plans for improving the supply to the Mount Royal Hospitals. The pump is too slight for continuous service and the buildings are only temporary. In consequence a new engine house will have to be built and another pump procured for use in case of emergency. The service pipes will also have to be relaid, as at present they run along the surface of the ground and would freeze in the winter. A special appropriation will be asked for to cover this necessary expense.

COHOES, N. Y.—The Northside water-works will cost about $75,000. No reservoir will be built. The water is to be pumped into iron tanks located on a hill back of the village. The elevation is 21 feet higher than the tower of the capitol at Albany. The water board of Albany will consider the advisability of building a reservoir at the above point to hold 100,000,000 gallons for storage, to connect with the distributing reservoirs at Albany. The plan includes a pumping station on the flats above Waterford, and the water to be taken from the Hudson above the covered bridge.

ANACONDA, Montana, is agitating the subject of water supply, mainly for fire purposes. The town where 26 months ago was bleak prairie now numbers 3200 inhabitants, and its water supply of street ditches and wells is inadequate even in summer, while the freezing of the former in winter still further reduces the supply.

A three mile tax on property within fire limits yields $1,600 this year and about $7,500 has been raised by private subscription. It is proposed to either tap the large main of the Anaconda Smelting Works or lay a new main from a point on Warm Spring Creek two miles above the town.

THE Weymouth, Mass., water-works are completed and ready for service. The water is obtained from the Great Pond. The pumping-station is supplied with a Blake Compound Duplex Engine. The standpipe is of boiler plate, and stands on a masonry foundation; i is 40 feet diameter, 75 feet high, with a capacity of 750,000 gallons. There is a high and a low service which can be connected in cases of emergency. This will give a head of 250 feet in the lower villages. There are over 33 miles of pipe, varying from 6 inches to 20 inches diameter. Mr. M. M. Tidd, Boston, was the engineer; Mr. W. C. McClallan, Chicopee, the contractor. The pipes were supplied by A. H. McNeal, Burlington, N. Y.; the gates and hydrants by the Chapman Valve Co., Indian Orchard, Mass., and the standpipe by the Cunningham Iron Works, Boston.

WHAT CONSTITUTES A NAVIGABLE STREAM.—According to the decision of the Supreme Court of Alabama in the case of Lewis et al vs. Coffee County, to constitute a navigable stream it is not requisite that there should be sufficient water for the common uses of trade and commerce during all seasons of the year. It must, however, as the results of natural causes, be capable of valuable floatage periodically during the year, and so continue long enough at each period to make it susceptible of beneficial use to the public. It must be of such character as to be of actual, practical utility to the public as a channel of trade or commerce. The court, applying these rules, held that a stream of which the only evidence of navigability was that it "was a stream upon which logs could be floated only at high water, or during a freshet, by the public generally, to Pensacola, Florida, where it was generally marketed," could not be adjudged a navigable stream.—*Bradstreets.*

ATLANTA, GA., Atlanta having bored over 2,000 feet of its artesian well and having sunk $26,000 in the hole, decided October 19th, to abandon the work, which has been in progress thirteen months and fourteen days.

Drilling was commenced on the fifteenth day of September, 1884, and the expense each day has been $21, independent of Colonel Baum's salary of $300 per month, and the wear and tear of the machinery. The force employed was:

Two drillers, per day	$3.50
Two tool dressers, per day	3.50
One general helper, per day	1.00
Fuel, per day	5.00
Total	$21.00

The machinery cost about $4,000, and is yet in good condition, and is worth, according to Colonel Baum's estimate, about $1,750. During the work four cables aggregating 11,500 feet have been used.

MANY letters were sent to the N. Y. Board of Health last month by persons living in the Annexed District, complaining about the bad quality of the water in the Croton mains. Among others, Mr. Wilts, Third avenue and One Hundred and Fifty-Third street, wrote that the water in the district had been "very impure, leaving a large deposit of reddish matter." A plumber employed by Mr. Wilts opened a blocked up pipe and found an eel, 12 inches long. Mr. Wilts thought that dead fish had caused "the fishy smell and oily taste in the water last summer." Sanitary Inspector Comfort reported that he had noticed the sediment in the water, and had frequently heard of water pipes being stopped up by dead fish.

A report by Dr. Cyrus Edson laid before the Board of Health, stated that the sediment and offensive odor and taste, probably resulted from the partial decomposition of the water in "dead ends" of the mains. There are many miles of "dead ends" in the annexed District, because the engineers have been obliged to lay a network of water mains in parts of the district where there are few houses. Dr. Edson thought that trouble could be avoided by opening the hydrants frequently in such parts of the district. His report will be forwarded with a suitable recommendation to the Department of Public Works.

NEWS OF THE WEEK.

Contracting.

Bartholdi Statue.—The Shiffler Bridge-works, Pittsburg, are making the steel girders for the Bartholdi statue.

Federal Building.—The contract for stone masonry on the federal building at Louisville, Kentucky, has been awarded to Oman & Stewart, Nashville, Tenn., at their bid of $43,107.

New Sidewalk Process.—SAVANNAH, Ga., October 19.—The city has contracted with John H. Wynkoop, formerly of Atlanta, to lay considerable sidewalk by his process of making stone of cinder. He will locate his plant, now lying in Atlanta, in this city.

Pumps, etc.—The contract for furnishing and delivering in the Mare Island Navy Yard, steam pumps under requisition No. 94 of the bureau of steam engineering, has been awarded to H. P. Gregory & Co., of San Francisco, California. Parke & Lacy, of the same city, were awarded the contract on requisition No. 92, hoisting, engines, etc.

Large Contract for Pipe.—HARRISBURG, PA. Oct. 22.—The American Tube and Iron Company, located at Middletown, is now completing a contract for thirty-six miles of iron pipe for the Standard Oil Company, to carry gas from the wells at Ludlow, Warren county, to Johnstown, N. Y. This is one of the largest contracts ever made for tubing of this character.

Philadelphia Sewers.—Chief Engineer and Surveyor Smedley, Oct. 20, read before the Philadelphia Councils Committee on Surveys a list of the awards of contracts for constructing about forty branch sewers. Contractor George W. Hansell sent a letter in which he said he was the lowest bidder for sewers on Girard Avenue and Twenty-seventh street. His price was $1.88 per foot, but the award was given to M. C. Hong, who however, sent in his bid a day late at $1.73 per foot. A readvertisement for bids was ordered.—*The Press.*

Sewer.—Bids for building a brick sewer eighteen inches in diameter at Hartford, Connecticut, have been received as follows: M. O'Neil, 72 cents per foot and $43 for the required manhole; S. Bissell, 70 cents per foot and $22 for the planking needed in places to support the sewer: H. R. Tryon, 73 cents per foot, $30 for planking and $25 for the manhole; S. Cotter, Jr., 65 cents per foot, $27 for planking and $35 for the manhole. The contract has been awarded to Mr. Cotter. The sewer will be about 1,200 feet in length. Work will be begun at once.

Opening of Bids.—The following bids for removing the wreck of the steamship "Perkiomen," which lies in about eight fathoms of water in the Atlantic Ocean off Cape Cod, and about three miles northeast of Pollock Rip Lightship, eastern entrance to Nantucket Sound, and landing at the harbor of New Bedford or Boston such material as can be saved, were opened by Col. Elliot October 23.

Wm. E. Chapman, Brooklyn, N. Y.	$7,480
Adoniram Fairchild, West Stratford, Conn	9,500
Atlantic & Gulf Wrecking Company, Somers Point, N. J.	9,900

Contract awarded to Wm. E. Chapman.

The B & O Schuylkill Bridge.—An accident occurred last week at Caisson No. 4, of the B. & O. Bridge across the Schuylkill river in Philadelphia. This caisson is 40 by 22 feet and is being sunk in 14 feet of water. At the time of the accident the caisson was down 11 feet in the mud; this mud lay in strata of varying density and this condition of affairs was charged with some of the trouble that followed. At this time the margin between the dead weight of the caisson and the upward pressure of the confined air, was slight, and on October 22nd, the caisson commenced to rise slowly and to list over to the East; this movement brought a strain on the air-pipes and broke them off. The air then began to escape and the caisson to settle, but it finally landed out of its proper position. Nine men were in the working chamber at the time but they escaped into the air-lock and were practically in no danger. The caisson careened very considerably, in its new position, and the contractors are now engaged in righting it again. It will occasion some slight delay in that foundation.

Mr. Squire Wants Four and a Half Millions.—Commissioner Squire asks the Boards of Estimate and Apportionment this year to appropriate $4,498,000 for the N. Y. Department of Public Works. This is nearly double what was allowed his department last year. The greater part of the increase is for repairs and improvements in the water system, which he says will be necessary to keep the city supplied until the completion of the new aqueduct, about five years hence. He proposes to expend $150,000 in placing registers for water consumption in front of various buildings. He also wants a large sum for repairing the Navarro water meters. The following are some of the new items of expenditure which Mr. Squire proposes: Boulevards, roads, and avenues, maintenances, $20,000; contingencies, $10,000; free floating baths, $10 000; laying water pipes, $50,000; public buildings, constructions and repairs, $25,000; removing obstruction, $10,000; repairing and renewal stop cocks, etc., $100,000; repairing streets and avenues, $292,000; surveys, maps, etc., $10,000; water supply, Twenty-fourth ward, $10,000; repairing Fifth avenue, $294,000; boring for grading and sewer contracts, $18,000; street signs on bridges and public lamps, $20,000; special appliances to suppress waste of water, $100,000; Gansevoort Market, $468,000; rebuilding Clinton Market, $150,000; new Hall of Records, $250,000; boulevards, roads and avenues, maintenance, $200,000.

Railroads, Bridges and Canals.

Memphis, Holly Springs & Birmingham Railroad.—The survey has reached Marion County, Ala.

The Norfolk & Western Railroad will complete its Cripple Creek extension, 45 miles in length, by March 1.

The Chicago, Burlington & Quincy will soon be extended from Carrollton, Missouri, to Fort Scott, Kansas.

R. R. Litigation Ended.—The suit of James McHenry against the N. Y. L. E. & W. R. R. has been finally disposed of.

The Fifth Avenue Railway Co. has offered the abuttors along its route the privilege of subscribing for $1,000,000 of the capital stock.

Jeffersonville & Terre Haute.—The projectors are securing the right-of-way, and surveyors are already at work in southern Indiana.

Elkhorn Valley Terminus.—Rapid City, Dakota, has offered $75,000 for the terminus of the Elkhorn Valley road, and expects to get it.

Work Resumed.—Work has been resumed on the construction of the Milwaukee & Northern Railway extension in Green Bay, Wisconsin.

Lake Michigan and Ohio River Road.—Work on the extension from Toledo to Brazil, Ind., about fifty miles, is being actively pushed.

R. R. Bridge Burned.—BENNINGTON, VT., Oct. 15.—The Troy and Boston Railroad bridge, at the State line near North Hoosic, N. Y., was burned to-day.

Marshall & Northwestern.—It is decided the line will run to Paris, Tex. Work is in operation from Marshall, and will soon be commenced southeast from Paris.

Mineral Range R. R.—Right-of-way has been granted across the Calumet and Hecla location for an extension of the Mineral Range Railroad, Mich., which will probably be built in the early future.

Canadian Pacific Railroad.—The last spike will be driven on November 5. Only eleven miles of the gap between the uncompleted ends of the road remain to be finished.

The Proposed New Bridge.—MONTREAL, October 22nd.—The Canadian Pacific has extended the time for receiving tenders for the construction of the St. Lawrence bridge until the 4th. of November.

Kansas Railroads.—The construction of the Topeka, Salina and Western railway through to Salina, is now an assured fact. The construction of the Salina, Lincoln and Northwestern railway will be commenced at once.

Russian Pipe Line.—The project of laying down a conduit for conveying naptha from Baku to Baton has been favorably reported upon by the Minister of Public Works and Lands. A private company has offered to construct this pipe, which would be 800 versts or about 530 miles in length.

Lake Superior and Southwestern.—Men are being hired at Duluth, Minn., to work on the grading of the Lake Superior and Southwestern railroad, which is to run from Duluth via the St. Louis bridge and West Superior, to Taylor's Falls and southwesterly. Surveys for the line were made years ago.

Panama Canal.—A report has been received by the Secretary of the Navy from Rear Admiral McCauley at Panama stating that everything is quiet there. Work on the canal is at a standstill at the Pacific end, but at the other end for a distance of three miles from Colon one-half of the depth and less than the width of the cutting has been excavated.

Fall of a Worm-Eaten Bridge.—ATLANTA CITY, N. J., Oct. 27.—About 150 feet of the bridge of the Pleasantville and Atlantic City Turnpike Company fell this afternoon while some fifty persons were on it. Many of them were thrown into the water, but, fortunately, no one was drowned. The cause of the accident was the eating of the piling by worms, until it was honeycombed.

A New Line in Kansas.—TOPEKA, KAN., Oct. 25.—The Secretary of State has issued a charter to the Colony, Southern and Western Railroad Company, with a capital stock of $3,400,000. The road is to be constructed from a point at or near Colony, Anderson County, through the Counties of Anderson, Allen, Coffee and Woodson to Neosho Falls; thence to Yates Center; thence in a southerly direction, through the Counties of Woodson, Wilson and Montgomery, to the City of Independence—the estimated length of said line and branches being 170 miles. The place of business of said road is to be in Topeka, and the nine Directors of the corporation for the first year are: Joab Mulvane, John R. Mulvane, J. P. Guswald, G. F. Parmelee, A. W. Knowles and J. T. Shellabarger, all of Topeka; D. W. Finney, Neosho Falls; Q. J. Hudson, Fredonia, and R. N. Allen, Chanute, Kan.

Connecticut & Western Blocked.—A large gang was at work on the 23d, clearing the track. The slide was 80 feet long, and the mud was 4 feet deep on the track. Being in a deep cut, progress was slow.

Ohio Central R. R.—The river division of the O. C. R. R., and the bridge over the Ohio, have been sold. The completion of the bridge will be pushed and the line above Charleston, W. Va., will be carried forward after April 1, 1886.

The Hoboken "L" Cable R. R. was tested October 19th. The grips, which were invented by the chief engineer, Mr. Endreas, proved satisfactory, and will be fitted to all the cars. The road will be formally opened about the middle of November.

Natural Gas.—SHARON, PA., October 23.—A vein of natural gas was struck this afternoon at the Pine Hollow well, half mile east of Sharon. The pressure has not yet been ascertained, but it is thought that a larger volume will be found at a greater depth. The depth is 400 feet.

The Bostick and Tazewell Railroad.—The people of Marion are moving again in the effort to build a railroad from Tazewell to Bostick, N. C. The charter has been secured, and at a recent meeting it was determined to open books of subscription. The indications are that the road will be built.

200 Ton Gun.—The immense gun constructed at Elswick for the British Government has a trial weight of 200 tons, being considerably in excess of previous undertakings. Its length is stated at some forty-four feet, though with an extreme diameter at the breech of but five feet six inches, a very elongated chase or barrel tapering down to twenty-eight inches, with a slight swelling at the muzzle.

Surveyors Instruments.—The Secretary of the Treasury decides that engineers' and surveyors, instruments are not mainly or particularly designed for scientific purposes, but, being chiefly intended for industrial or practical uses, and being otherwise unenumerated, are dutiable as manufactures of metal and glass, at the rates assessed, or 45 per cent. ad valorem.

The Memphis, Selma, & Brunswick R. R. is to be reorganized as the Memphis, Birmingham, & Atlantic R. R. It runs now from Memphis to Holly Springs on the Illinois Central, from which point it will be extended sixty miles to the Mobile & Ohio road, and ultimately to Birmingham, Ala. Preliminary surveys have been made. Major Temple will be chief engineer of construction.

Croton Aqueduct.—The Secretary of the Aqueduct Commissioner reported that up to date $1,735,948 had been expended, and that there was a balance of $1,300,000 to the credit of the commission. Public Works Commissioner Squire presented a plan to have the southern terminus of the new aqueduct at One Hundred and Thirty-fifth street. The proposition was not looked upon with favor by the commission, and the matter was referred to the Chief Engineer.

Maine Railroad Prospects for 1886.—Work will no doubt be begun on the Lake Megantic, or, as it is now known, the International. There is also talk of building a railroad from the junction of the Monson Rail road to Skowhegan.

Another project is to construct a road from Milo Junction by way of Kenduskeag to Bangor. The distance is about twenty-seven miles, and the route is one easy to build. Prominent capitalists are said to be interested in this matter and intend to push the scheme.

English R. R.'s and Streets.—Mr. M. M. Greene, president of the Hocking Valley R. R., has recently returned from Europe, and being asked about English railroads said; "Their roadbeds are simply grand in their solidity. We have nothing anywhere approaching to them in this country. But their equipment is far behind us. The English desire and English society education prompt them to put up with miserable accommodations for the sake of privacy. Our people in this country would not submit to such accommodations as they accept over there. If our cars were put on their roadbeds it would make the most magnificent combination in the world. In freight transportation they are still further behind. They still use the old four-wheeled, small-sized cars, and the merchandise is covered over with tarpaulins and canvas tied down with strings. They do not know anything about box cars in actual practice. Some lines are introducing American cars for passenger traffic, but it is slow work."

Mr. Greene says that in the matter of streets the great cities of Europe that he visited, London, Glasgow and Paris, are so far ahead of this country as not to admit of comparison. "In London I saw on the Strand block paving and Nicholson paving of the most perfect character. It was laid with a care that we have never given to any paving in this country. Why, there was as much inspection of each one hundred feet of it as we put on each ten thousand feet. The result is that their paving is perfect and durable, while ours is a swindle and a cheat. It is the same way with their asphalt paving. They take care of it, keep it repaired, and it lasts indefinitely. A ride on one of their smooth pavements in any of those cities, makes a man dread to try a drive in New York."—*N. Y. Tribune.*

The Evansville, Washington and Brazil Road is progressing, and trains will be running into Terre Haute by the 1st of December. Brazil will be reached by a branch leaving the main track at Saline City, about fourteen miles distant.

A New Union Depot.—DUBUQUE, Io., October 23rd.—Articles of incorporation of the Union Depot Company to build a union passenger and freight depot in this city, were filled to day; capital, $100,000, with power to increase to $1,000,000. Its incorporators are J. C. Clark, President; Stuyvesent Fish, W. J. Knight, B. F. Ayer and J. C. Welling, Directors.

Hannibal and Southwestern Railroad.—STURGEON, Mo., October 22nd.—Col. J. T. K. Hayward, of Hannibal, and his party of surveyors, passed through this place yesterday on their way marking out the route for the Hannibal branch of the Missouri Central Railroad. The branch is to run from Rocheport via Harrisburg, Sturgeon, Florida, Perry, and on to Hannibal.

Brockville, Westport & Sault Ste. Marie.—A meeting of the board of directors of the Brockville, Westport, and Sault Ste. Marie railway was held in Brockville, Ontario. A cable message received recently from Mr. Cole, now in England, stated that the necessary financial arrangements for proceeding with the road were completed, and he was awaiting authority from the board to sign the necessary papers.

The Palestine Canal.—The Italian Consul at Jerusalem, in an official report, calculates that the projected Palestine Canal would provide a passage to the east of four hours less duration than the Suez canal; would be constructed at half the cost of the latter, and be maintained at much less expense, so that in consequence the tolls levied on ships would be about half those of the Suez canal. It would afford access to new countries and provinces among the most fertile in the world, and travelers to the Holy Land would arrive there with facility.

Smith's Falls Air Line.—A number of railway contractors are in Montreal for the purpose of preparing tenders for the St. Lawrence bridge and approaches. Some have also been drawn here by the report the C. P. R. would soon commance the Air Line from Smith's Falls to Lachine. A leading official of the C. P. R. stated a few days ago, that the question of building the line, was at present in abeyance. He said the C. P. R. must build this line some time or other, but whether in the near future or not, depends upon their success in selling the Ontario and Quebec bonds which are now being offered in the London market.—*Montreal Star.*

Railway Construction in Kansas.—TOPEKA, KAN., Oct. 22.—Grading was commenced last week on the O'Harra, Osage City and Council Grove Railroad. One thousand tons of steel rails are en route from Joliet. D. T. McIntyre and associates have the contract to build and put the road in running order before the 1st of January, 1886, through Osage County from Queene Mo., to Osage City. Price & McGarock, railroad contractors, have immediate charge of the construction and will put on a large force, and push things as rapidly as possible. The intention is to push the road straight through from O'Harra to Council Grove, where a connection will be made with the Topeka, Salina and Western.

Chesapeake & Nashville R. R.—The Merchant's Exchange of the City of Nashville obtained a subscription of $500,000 to bonds of the Chesapeake & Nashville Railway, 5 per cent. of which was due on commencement of work. So many rumors injurious to the road were circulated, and so many were influenced to believe that the road would not be built through, or would be leased or sold to the Louisville & Nashville that the confidence of the public was somewhat shaken and the 5 per cent. was not paid. The Merchant's Exchange appointed a committee to investigate the status and backing of the road, and the rumors afloat. They report that they believe it is the honest intention of the Chesapeake & Nashville Railway Company to build a through line between Nashville and the Chesapeake & Ohio Railroad system, competing with and uncontrolled by the Louisville & Nashville Railway, and recommend that the 5 per cent. of the subscription be paid at once, and that $6,000 be donated toward securing right-of-way in Davidson County, and that the city grant right-of-way through streets, and for Union Depot, and to give deeds for the Park for same. They believe that the work between Gallatin & Nashville would have been begun ere this, had the subscription been paid, and right-of-way secured as promised, and believe that work on same will be begun before March 1886.

This report guarantees that this important line will be pushed to a successful completion. One or two parties of engineers will be put in the field at once. Contractor Rodemer is increasing his forces and beginning some heavy trestle work and masonry. Tracklaying will begin early in spring. The bids for superstructure of bridges will be closed Oct. 31st. A large number of firms have made proposals. Chief Engineer Spradlin is arranging to push the work, and all disputed rights-of-way are to be settled at once.

The Missouri Pacific will build new shops at Atchison, Kan. They will cost $250,000 and employ 2,000 men. A railroad hospital, costing $25,000, will also be built.

A Religious R. R.—The motive power of the Montgomery Falls, near Quebec, is to be utilized to operate a railroad to the shrine of St. Anne, which attracts 80,000 to 100,000 visitors annually.

The Vicksburg & Meridian Railroad changed their gauge to the standard on October 22. The distance is 140 miles. The change stopped all trains during that day.

An Alabama Railroad.—Engineers are engaged upon the survey of the Nashville & North Alabama Railroad, which is to run from Huntsville to Elora on the N. & C. R. R., and it will be completed about the 10th of November.

The Shreveport & Houston Narrow Gauge R. R., has been completed to the Sabine River, where connections will be made with the Houston & East and West Texas road. The former road has already been opened for business.

West Shore Line Claim.—Judge Brown of the Supreme Court has decided that the claims against the road for supplies and labor furnished between March 1, and June 7, 1884, and estimated at $100,000, are valid and must be paid by receiver's certificates.

New York Street Railway.—ALBANY, Oct. 19.—The Citizens' Railway company, with a capital of $2,500,000, filed a certificate of incorporation to-day. The road will operate in the southwestern section of New York city.

South Atlantic R. R.—LYNCHBURG, VA., Oct. 23.—Work was commenced on the South Atlantic road, at Bristol, Tenn., yesterday. This road will connect with the Norfolk and Western at Bristol and will run to Big Stone Gap, Tenn., there connecting with the Kentucky system.

Dynamite Exploding Ahead of Time.—WASHINGTON, Oct. 23.—An explosion of dynamite cartridges, used in blasting the rock of the Washington Aqueduct Tunnel, occured recently by which James McDonald was killed outright, another probably fatally injured and several others hurt.

Chili's R. R. Debt.—SANTIAGO, CHILI, Oct. 23.—The debt of Chili for the construction of railways is $24,870,000. In 1883 these railroads earned a revenue of $3,516,049 on a capital of originally less than $60,000,000, which is now reduced to $22,450,000. The railways of the Argentine Republic are on the average earning an annual dividend of 6½ per cent.

Railroad Building in Tennessee is taking a spurt since the commission has been abolished. The Directors of the Nashville, and Chattanooga and St. Louis Railroad contemplate the extension of several important branches of the road. Other lines are projected by New York and Pennsylvania capitalists, and surveys are now being made for new enterprises.

Georgia Legislature.—The Governor has signed the following bills:

To incorporate the Athens and Jefferson Railroad Company.

To incorporate the Anniston and Chattanooga Railroad Comyany.

To incorporate the Atlantic and Mexican Gulf Canal Company.

A Gas Pipe Line Scheme.—Mr. R. H. Smith of Pittsburg, Pa., is at the head of a project to supply Philadelphia and New York, with natural gas from Pittsburg, by means of large pipes. It is to be used for fuel and illuminating purposes, and the scheme includes the supply of locomotive and trains. It is estimated that one filling of the tanks at Pittsburg, would be sufficient to drive a train from Pittsburg to Philadelphia and back.

Oil in Minnesota.—BROWN'S VALLEY, Oct. 23.—This neighborhood is considerably excited over the discovery of oil eight miles north of here. While digging for water at a depth of 85 feet oil in small quantities was found. Reports say fabulous prices are now being offered for the land. Those who pretend to know say that the oil found proves that the coal beds found some years ago east of here extend north from here.

Convict Labor on Public Works.—WASHINGTON, D. C.—Senator Van Wyck has requested Secretary Manning to make a condition with contractors for the construction of public buildings in Nebraska that convict labor should not be employed. In case the Secretary should think the law prohibits such a condition, the Senator asked that the bidders for contracts be required to state whether they propose to employ convicts upon public works.

The Georgia, Midland & Gulf R. R.—Chief Engineer Green and his corps of engineers are at work on the survey for the road. Maj. Green reports that he will secure a practical 1¼ per cent, grade over Pine mountain. This is the only difficult point on the road, and its engineering difficulties will be overcome. The corps will now make rapid progress both toward Columbus and Griffin.

The St. Joseph and Southwestern is the name of a new narrow gauge road, which will extend south and east from St. Joseph through the counties of Buchanan, Platte, and Clay, the terminus to be at Southville, in Clay County. The road is to be built and managed by a stock company composed mostly of St Joseph capitalists. The capital stock of $200,000 has all been subscribed, and the Board of Directors has pledged the company to construct the road as soon as $60,000 is given toward the enterprise by citizens living along the line and residents of St. Joseph.

A Voyage in a Dredge.—The large new marine dredge No. 19, built for the canal company, arrived yesterday at Panama. This dredge, which was built at Renfrew, near Glasgow, by M. M. Loebnitz & Co., made the passage alone from Glasgow through the Straits of Magellan in 88 days. Capt. Amundsen says that his clumsy craft behaved remarkably well, although he regrets that the passage was one of such uninterrupted calm that he had not an opportunity of testing her qualities as a sea boat. Only four stoppages were made—at St. Vincent, Cape de Verde Island, on July 24th; at Montevideo, August 13th; at Sandy Point, Straits of Magellan, August 29th, and at Valparaiso, September 11th. The mean speed attained was 8½ knots an hour. The crew numbered twenty and the engine is of 280-horse power. The dredge is 176 feet long, 40 feet wide and 12 feet deep. Her appearance at sea caused much excitement, especially among sailing ships which wondered what new kind of craft had been introduced to compete with them.—*From the Panama Star and Herald, Oct. 1.*

Railways at the Cape.—The last section of the eastern system of the Cape of Good Hope railways terminating at Aliwal North, was opened in August, thus completing the entire system authorized, with the exception of the Western line to Kimberley (Diamond Fields) which will shortly be finished. The three railway systems,—Western, Midland and Eastern,—comprise in all 1367 miles, which with the few loop lines, such as the junctions to King William's Town, Malmesbury, Grahamstown, and Colesberg; and the private compans's line from Port Alfred to Grahamstown; being the total that the colony has in actual working order to 1,562 miles, representing an outlay of $71,943,000. The Kimberley extension, about 80 miles, probable cost of which is $2,000,000, will increase this total to 1,642 miles, and the expenditure to $73,943,000. During the first six months of the current year the railways have yielded returns sufficient to pay all maintenance and working expenses, leaving a surplus of nearly 3½ per cent. towards payment of interest on capital expended for construction.

Market Report of Engineering Materials.

New York, October 29, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.95	@	2.05
Tee	2.2	@	2.4c.
Beams and channels American	3.0c.	@	
Tank	2.	@	2.1c
Shell	2.4c.	@	2.5c
Steel plates, Tank	2¾c.	@	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.			
Butt welded, black ....Discount	42½	@	45
" galvanized .... "	32½	@	35
Lap welded black .... "	60	@	62½
" Galvanized .... "	45	@	42½
Boiler tubes .... "	57½		
RAILS.			
Steel (large lots at mill)	30.00	@	31.00
Old rails	17.25	@	18.50
Old rail steel	17.00	@	18.00
R R. spikes	1.8	@	1.9
R R. splice-plates	1.65	@	1.7.
R R. Track Bolts Square Nuts	2.55	@	2.65
Barb-wire fencing, galvanized			4.50
" painted			3.50
Corrugated iron			
Nails			
Iron, per keg	3.00		
Steel do.	3.10		

METALS.

COPPER.			
Lake Superior	11	@	11¼
Other Brands	10	@	10⅛
LEAD.			
Com. Domestic	4.15		
Lead Pipe	.06¾		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.06¾		
ZINC.			
Sheet	5.75	@	6.00

BRICK.

(Cargoes afloat)			
Haverstraw ....per M.	$5.75	@	6.00
Fishkill			
Up-River	5.25	@	5.87½
Jerseys	4.50	@	5.50
Long Island			
" pale			

FRONTS.			
Croton red	11.00	@	14.00
" dark	11.00	@	14.00
" brown	10.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	40.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

BAETJER & MEYERSTEIN:			
Hanover Portland	$2.60	@	$2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S	2.55	@	3.00
BROOKS, SHOOBRIDGE & Co.	2.55	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs	2.65	@	2.90
K. B. & S. "	2.75	@	2.95
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fieve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			1.10
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.40
LAWRENCE CEMENT Co.:			
Hoffman Rosendale			
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse	4.50	@	5.00
" Fine	8.00	@	10.00
" Portland	2.45	@	2.85
NEW YORK CEMENT Co.:			
Rosendale			1.20
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.60
SINCLAIR & BABSON:			
Alsen's Portland	2.45	@	2.75
STANDARD CEMENT Co.			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT CO.:			
Windsor	1.00	@	1.10
Standard			1.15
Cable's Portland	2.15	@	2.40
UNION AKRON CEMENT Co.:			
Akron "Star" brand.			

ASPHALT.

Prices range per ton	$15 00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			

LIME.

Rockland common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	0.95		
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.			
Amherst freestone, No. 1 per cub. ft.	0.90	@	95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75	@	1.00
Brownstone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.0
" Choice "	55.00	@	80.
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¾ × 4 to 4 × 6, in	.17	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2.10	@	2.25

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" " in oil pure "	.05½	@	.05¾
English, B. B. in oil	.08½	@	.08¾
Red, American	.05½	@	.05¾
Litharge "	.05	@	.05¼
Venetian red, American "	.01	@	.01¾
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11¾
Paris green "	.18	@	.19
Umber, Amer. raw and powdered per lb.	.01¼	@	.01½
Drop black, Amer. "	.08	@	.12
" " "	.09	@	.11¾
Chrome green "	.05	@	.15
Oxide zinc, American "	.03¾	@	.04
" French "	.06¼	@	.06¾